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ENVIRONMENTAL RESEARCH AND DEVELOPMENT

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SUBCOMMITTEE ON TOXIC SUBSTANCES AND
ENVIRONMENTAL OVERSIGHT

OF THE

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CONTENTS

Page

Durenberger, Hon. Dave, U.S. Senator from the State of Minnesota, opening statement of ... 1

WITNESSES

Bernabo, Dr. Chris, executive director, national acid precipitation assessment program ... 18
  Written statement ... 188
  Responses to additional questions ... 208
Bridgewater, Dr. Albert L., Acting Assistant Director, Astronomical, Atmospheric, Earth, and Ocean Sciences, National Science Foundation ... 29
  Written statement ... 245
  Responses to additional questions ... 262
Edington, Dr. Charles W., Associate Director, Health and Environmental Research, Department of Energy ... 27
  Written statement ... 213
  Responses to additional questions ... 231
Ostenso, Dr. Ned A., Acting Assistant Administrator, Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administraton ... 30
  Written statement ... 266
  Responses to additional questions ... 272
Peck, Dr. Dallas L., Director, U.S. Geological Survey ... 11
  Written statement ... 114
  Responses to additional questions ... 174
Rall, Dr. David P., Director, National Institutes of Environmental Health Sciences ... 7
  Written statement ... 81
Riordan, Dr. Courtney, Acting Assistant Administrator for Research and Development, Environmental Protection Agency ... 3
  Written statement ... 40
  Responses to additional questions ... 56

ADDITIONAL MATERIAL

Environmental health research and development and other environmentally related activities in the Department of Health and Human Services ... 91

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

MONDAY, OCTOBER 17, 1983

U.S. SENATE, COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS, SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT,
Washington, D.C.

The subcommittee met at 10 a.m., in room SD–406, Dirksen Senate Office Building, Hon. David Durenberger, chairman of the subcommittee, presiding.

Present: Senator Durenberger.

OPENING STATEMENT OF HON. DAVE DURENBERGER, U.S. SENATOR FROM THE STATE OF MINNESOTA

Senator DURENBERGER. The hearing will come to order.

This is the second of two oversight hearings on the subject of Federal environmental research and development. The subcommittee heard testimony on June 14 from representatives of State and private organizations attesting to their need for Federal environmental R&D to support a wide range of public health and environmental programs.

Today we will hear from those Government officials who administer these vital R&D efforts. The programs provide scientific and technical information necessary to formulate the sound environmental policies of the past decade and a half. Our R&D programs have served us well, as evidenced by the visible progress we have made in diminishing the degradation of our air, water, land, and oceans.

However this is no time to lessen our efforts. We are now in the process of reorienting our perceptions of the most threatening environmental problems. Until recently we thought we had a handle on air and water pollutants; now we realize there are literally hundreds of toxic substances of potential or unknown risks finding their way into the air, water, and land. We used to think that the source of pollution defined the area of the problem. Now we know that a source in one place can have a severe negative effect thousands of miles away.

We used to concern ourselves with the acute toxicity and harmful effects that one could immediately see. Now we know that just as deadly and much harder to manage is chronic toxicity where the effect is cumulative and long term.

In addition, with each new environmental problem, we are reminded of the inseparable connections between the air, land, and surface and ground waters faced with the fact that the harmful byproducts of human activity are simply being shifted from one media to another. It is clear to this Senator that environmental decisionmaking is not going to get any easier. Therefore, we are in real need of sound research programs to clarify the nature of those problems and how to solve them.

There have been significant reductions in most of the agencies' environmental R&D budgets over the past several years. I think it is particularly important, at a time of financial constraint, that we ask the difficult questions. I expect the testimony presented today will help to answer some of these.

Are our current research priorities coincident with the environmental problems of key public concern in making the most of our financial and personnel resources through Federal, State, private, and cooperative efforts? Are we conducting programs adequate to meet short-term regulatory and decisionmaking needs? Are we at the same time furthering our long-term understanding and ability to anticipate future problems? Are those agencies responsible for research carrying on dissemination of this information to decisionmakers and other users?

There is another question that I would add to the list to the extent that any of you care to respond to. That is, my perception of research and development is not like a water faucet where you can turn it off and on depending upon the politics of this country. I will ask anybody who cares to elaborate on their own statements to address the subject. That is the need, in this country, to make some long-term decisions and long-term commitments to research and development. Particularly in the public sector; the role that we play in contracting with, for example, university-based research efforts and the inconsistencies in the delivery of information that result from our failure to make clear our commitment to what has been in America, part of a worldwide effort to develop information that is helpful to the environmental decisionmakers.

So I look forward to hearing all of the witnesses with the answers to these and many other questions. I hope what we learn here today will improve our collective capability to make sound decisions based on valid and complete information and thereby preserve the strong national interests in public health and environmental protection.

The witness list is headed up by the executive director of the national acid precipitation assessment program. Unfortunately Chris has been delayed and will move down the list and we will call Dr. Courtney Riordan, Acting Assistant Administrator for R&D for the EPA.

Maybe I can get the next two people on the list to come up also, Dr. David Rall, Director of the National Institute of Environmental Health Sciences for NIH and the Department of Health and Human Services and Dr. Dallas Peck, Chief Science Adviser to the Secretary and Director of the Geological Service, if he happens to be here.

Come on up. What I would like to do is to give you relatively free rein. You have very substantial statements which, if nobody here would object, will be made part of the record. But I don't want anyone here to feel limited in any way. This is the first day after a recess. I don't see an awful lot of my colleagues sitting around here. I can submit a long list of questions that you may not have answered in your statements for you to answer as part of the record after I have had an opportunity to read all of those statements.

So I want you to feel free to take whatever time you feel necessary to summarize those statements and to add any other dimension that you might to your testimony. We will start with Dr. Riordan.

STATEMENT OF DR. COURTNEY RIORDAN, ACTING ASSISTANT ADMINISTRATOR FOR RESEARCH AND DEVELOPMENT, ENVIRONMENTAL PROTECTION AGENCY

Dr. Riordan. Thank you, Mr. Chairman. As you point out my written statement is quite long and goes into a great deal of detail about the research program within EPA. I would like to simply submit that to the record and have some relatively short introductory remarks and then try to answer whatever questions you might have concerning the EPA research program.

I have with me in the audience assistants from the Office of Research and Development. So if you would bear with me in case of specific questions to which I am unable to respond, if I could defer to those individuals, I would appreciate that, Mr. Chairman.

I would like to start by saying our 1984 appropriated budget for research and development within EPA is about $245 million and about 1,787 work-years. This represents an increase of $19 million above the resources appropriated to us in 1983, and a decrease of 75 work-years.

As part of our program we are taking several major actions to improve the scientific quality, relevance and usefulness of our research products. One of our highest priorities is to improve the quality and validity of the data that we generate by implementing and monitoring a vigorous quality assurance program within EPA. An agencywide Quality Assurance Committee has been established to oversee quality assurance efforts and to recommend any necessary remedial measures.

In addition we are writing a manual to carefully describe the specific roles managers within ORD and throughout EPA must assume in implementing quality assutance throughout their programs. In the Office of Research and Development, for example, we are putting about $1.1 million in addition to the 1983 program into the quality assurance area to improve quality assurance within our own program.

Senator Durenberger. Can I stop you there before you go to the next subject? On the Intelligence Committee we deal a lot with quality assurance. We generate information until it is coming out of our ears but there are some of us who are sensitive to the fact that we don't know how to use that information. When we talk quality assurance in this area, what are we talking about? Is there some comparability to the example I just gave you?

Dr. Riordan. I think, in a sense, that we would like assurance that the data to be used has some understood precision and accuracy and that we can put confidence in that data. In the Agency right now we are promoting the idea that managers in the specific program areas are directly responsible for using the data and therefore should be responsible for establishing the level of precision and accuracy that they would like to achieve with that data. We in ORD provide them with technical guidance as to how they may do that. We also provide oversight in terms of reviewing the management of their programs to assure that they do have in place adequate procedures to provide the data quality that they say they would like to have in making their decisions.

Senator **Durenberger**. Is that like prespecking your bidders or something?

Dr. **Riordan**. Yes, it is. What it says is that you require that people that go out and actually take measurements in the environment obey certain kinds of procedures where they have duplicate, triplicate sampling, where they have controlled procedures in the labs when they carry out their analysis, that they have blanks and spikes and all kinds of mechanisms that we introduce into the measurement program to assure us that we are getting quality.

Senator **Durenberger**. So it is not quite like my intelligence example. What you are saying is that you want to make sure that you have got quality information coming in. My question was more relative to the way in which that information is used.

Dr. **Riordan**. That level of quality assurance is not part of the program.

Over the past year—I should mention there have been some proposals to reorganize the Office of Research and Development, but Mr. Ruckelshaus has as a result of his taking over the Agency examined the research program as well as other parts of the program and has concluded that major revisions and reorganization of the Office of Research and Development are not required at the present time and the problems if they do exist can be dealt with by management initiatives within the existing organization.

We also aim to improve the timeliness and usefulness of our research products through several internal management reforms. First, we have modified our planning process to strengthen further the linkage between research function and the client offices within EPA. In consultation with our clients we have developed strategy documents at the highest level of the ORD and program office organizations. Their purpose is to allow the managers of research and managers of the program offices to set strategic directions in terms of budget and program content which provides the kickoff to our annual budgeting activities and which provides more of a top-down direction in cooperation.

Senator **Durenberger**. In addition a broad research strategy that actually links up with some of the regulatory decisionmakers.

Dr. **Riordan**. That is right. It is your type of intelligence in terms of directing research programs. As I said earlier we have not gotten to that stage of quality assurance where we actually examine how decisions are made and how information is used in making those decisions in the program offices. That is a higher level of oversight that is not in the research program.

A second thing we are doing is developing and implementing an automated information system relative to our research programs so that we will have complete documentation of what is going on in the research program. We will have accountability built into that information system because resources will be attached to projected program outputs and also we will have immediate reporting capability in all of our programs. So we think that is going to be a major improvement in our ability to communicate what is going on and to track what is going on in our research program.

I would like now to turn briefly to some of the fiscal year 1984 research areas. In the air medium we are accelerating the development of comprehensive health assessment documents for the evaluation of the potential risk from selected air pollutants that are under consideration for section 212, the air pollutant section of the Clean Air Act. Over all we are increasing the scientific assessments program by $2.2 million. In the water quality area we are targeting increases primarily in support of the Office of Water Quality and their need to address problem areas that will exist beyond the implementation of best available treatment technology, best practical technology and secondary treatment.

The States anticipate that the technology requirements under the Water Act will not be adequate to deal with water quality problems that will persist in some highly polluted areas and our job in the research program is to provide them with the technical data and technical methodology that will be necessary to deal with that problem.

Another area of increase is acid rain. It is augmented by $2.4 million for a total of $15.4 million in 1984. The total Government acid rain funding in 1984 will be $27.6 million an increase over $23.3 million in 1983. The areas that will be emphasized in those increases are dry deposition monitoring methods because at the present time we are not measuring dry deposition. We opted to take State of the art technology today and deploy that in a limited number of areas to test out our ability to actually measure gas phase pollutants in the atmosphere and predict high, dry deposition because we think that is an important component of the total deposition picture.

We are also increasing the amount of research in the area of terrestrial effects, forest effects from acid rain.

Senator **Durenberger**. Can I ask you at that point, I notice that the second Administrator of EPA temporarily opted acid rain out of their business with the Canadians and now we are going to go to phosphorous to keep them happy for a while. Where will that all come in? Is that the Great Lakes study that is in your statement?

Dr. **Riordan**. The phosphorous work is with the water quality program. Yes, Senator.

Health research is funded at almost $50 million in 1984. This is an increase over 1983 of about $9 million. The increase primarily is in the area of toxics health effects research, most of which is for improving techniques for extrapolating research effects from animals to human beings, trying to do better epidemiology studies and in developing better test methods.

The 1984 appropriation also allows for continued support of other critical programs at approximately the same level as 1983. Ground water research will continue to contribute to the scientific and technical information base to help us respond to ground water pollution problems through the various environmental statutes.

In 1984 we will have some studies funded in the area of Temik contamination of drinking water which is a major concern in the ground water area today.

Our Superfund support program increases by $2.3 million and emphasizes quality assurance activities supporting site assessments and field evaluation of control technologies for remedial and cleanup actions in the field.

In our exploratory research program, which is concerned with long-term research, we are continuing that at the same level of funding in 1984 and we are instituting some changes in order to make the program focus more effectively on what we perceive to be the long-term agency needs. The exploratory research centers program, for example, is an area where we have redesigned the planning and management of those centers so that their work will be more focused and of more utility to the Agency.

Similarly in the grants program we are instituting procedures that will allow the program offices to have a say in what grants are actually awarded to try to increase the degree of relevancy in our grants program.

There are some reductions in the budget.

Senator **Durenberger**. Before you get to that, in your statement, you said that this latter research program has been up by 13.4 percent. I think I have that right. You are now at 25.8 percent and there has been some consolidation of programs. Did I read it right? That consolidation covers this area?

Dr. **Riordan**. There is a consolidation, Senator. But it is not a real increase in the work. What it is is a change in the budget categorization of long-term research, to pull the long-term research out of the media categories and put them all into the interdisciplinary medium. It is strictly a paper shift, not a real shift in terms of dollars.

Senator **Durenberger**. How many dollars do you have for the eight academic institutions throughout the country?

Dr. **Riordan**. I don't have a specific number. I believe they are funded at a level of about $450,000 or $500,000 apiece. That would be about $3.4 million.

Senator **Durenberger**. Then how much is in the competitive research grants program? That covers sort of everything else?

Dr. **Riordan**. It is about $9 million. If I could, I could get you the exact number.

Senator **Durenberger**. We will get that later on. Now you are going to talk about reduction.

Dr. **Riordan**. OK. These reflect, these reductions, the completion of work in several programs and the reorientation of the program away from areas that are not directly relevant to EPA's legislative priorities.

The largest reduction is $4.9 million in the environmental engineering program. Control technology budget reductions reflect a shift of program emphasis toward evaluations of controls developed by the private sector, laboratory research associated with developing a fundamental understanding of the treatment processes and a continuation of emission evaluations from a wide variety of sources to assess the need for additional controls, and a strengthened technical assistance program that responds to the needs of regions, States, and local governments. Capital-intensive demonstrations and control technology development have been reduced in those areas which are best addressed by the private sector. A notable exception, however, is the continued development of the limestone injection multistage burner [LIMB], which supports the acid rain research program and which, through preliminary tests, is proving to be cost-effective control technology and continues to be supported in the 1984 budget.

Senator **Durenberger**. Why is that? Why is everything else in the control technology and you go into the private sector with that in hand? How do you make that decision?

Dr. **Riordan**. I think it is based primarily on the need to get something available as soon as possible, Senator, and that justifies the participation of the Federal Government; the urgency of the problem.

Senator **Durenberger**. Does that lead us then to draw the conclusion that we can wait on the private sector with other control technology?

Dr. **Riordan**. The judgment is that the control technology research going on in other areas is up to adequate speed, I believe. Yes, sir.

I also should note that the research to support the effluent guidelines has been largely completed and we will see a reduction in that area.

At this point, I think it would be best if I stopped my formal presentation, Senator, and simply make myself and the staff available for any comments or questions that you might like us to respond to relative to the details of the program or some of the general outlines of the programs.

Senator **Durenberger**. Thank you very much.

Dr. Rall?

STATEMENT OF DR. DAVID P. RALL, DIRECTOR, NATIONAL INSTITUTES OF ENVIRONMENTAL HEALTH SCIENCES

Dr. **Rall**. Thank you very much, Senator.

It is a pleasure to be here this morning to describe the environmentally related research and development activities in the Department of Health and Human Services.

I am Dr. David P. Rall, Director of the National Institute of Environmental Health Sciences [NIEHS], the National Institute of Health [NIH], and the National Toxicology Program [NTP]. I would like to introduce in the audience senior scientists from our department: Dr. Richard H. Adamson, Director, Division of Cancer Cause and Prevention of the National Cancer Institute [NCI], NIH; Dr. Vernon N. Houk, Director, Center for Environmental Health, Centers for Disease Control [CDC]; Dr. J. Donald Millar, Director, National Institute for Occupational Safety and Health, CDC; and Dr. Robert J. Scheuplein, Acting Deputy Director for Toxicological Sciences, Bureau of Foods, Food and Drug Administration [FDA].

Role of the Department of Health and Human Services.—The role of this Department in environmental research is focused primarily on the protection of human health from the adverse effects of exposure to potentially hazardous substances in the environment. Our activities in this regard encompass the identification of such substances, developing an understanding of their mechanisms of action and finding more effective methods to respond to or ameliorate their damage to the human system.

In the broadest sense the Public Health Service has been involved in environmental health research since its inception. The focus has shifted since the problems of the science have changed. In just over 20 years environmental health research has evolved into a very complex, sophisticated field. Today we know of at least 65,000 chemicals potentially in use in this country. Most of these, we think, can be used safely.

Our primary task is to identify those that can cause disease and death. Environmental health scientists given adequate time and resources can get quite good information from animal toxicity studies, the primary tool in this field. In some cases we have good corresponding human health effects data from epidemiological studies. However, there remains great difficulty in getting adequate measures of human exposure. Thus it is usually a problem to correlate various levels of exposure with specific estimates of health risk.

Let me briefly summarize some of the research activities. The National Institute of Health has the largest basic research and development effort in environmental health within the Department. The various institutes, particularly NIESH and NCI, are involved in a wide range of activities from the study of the structure of DNA and the function of genes to increase the understanding of how the genetic code operates and how damage from chemicals can cause mutations, cancer, birth defects, and other health problems.

We support a large prospective epidemiological study, attempting to rclate air pollution to pulmonary function study and development of sensitive methods to detect the binding of environmental carcinogens to DNA of individuals potentially exposed to such substances, the use of monoclonal antibodies to relate the individual's enzyme activity to his sensitivity to environmental carcinogens, understanding the effect of toxic substances on the processes of growth, maturation and adaptation and developing organisms, investigation and the effects of the molecular level of certain industrial pollutants such as carbon monoxide, silica, and asbestos.

The exploration of the level of environmental and genetic factors in oral-facial malformations and studies of the neurotoxic effects of heavy metals and our artificial food coloring.

At the Centers for Disease Control [CDC] the principal focus for environmentally related research is the National Institute for Occupational Safety and Health [NIOSH]. NIOSH performs research on safety and health problems in the workplace and makes recommendations to the Occupational Safety and Health Administration [OSHA] and the Mine Safety and Health Administration [MSHA] for standard setting in the workplace environment. NIOSH also participates in CDC's performance of toxicological studies on problems of potential public health significance. CDC's recently established Center for Environmental Health [CEH] investigates outbreaks of disease and health risks potentially related to environmental hazards. Recent CEH studies included dioxin exposure in Missouri, health effects of lead exposure near smelters and PCB exposures, and the Love Canal cytogenetic study. CEH also measures public health problems related to natural disasters and injuries, and is establishing population-based surveillance of disease and reproductive outcomes likely to be associated with environmental hazards.

The Food and Drug Administration [FDA] develops multiresidue surveillance analytical methods for the detection of pesticides in foods and for food contaminants such as industrial chemicals. They also measure the toxic properties of food additives and specific components of food, both natural and man-made. Much of this latter work is under way at the National Center for Toxicological Research [NCTR].

The National Center for Health Statistics [NCHS] has several major data collection programs including ones which are extensively used by, and developed in response to, other PHS components. These include: the National Vital Statistics System and surveys that obtain data from extensive physical examinations and personal interviews, such as, the National Health and Nutrition Examination Survey and the National Health Interview Survey.

The Alcohol, Drug Abuse and Mental Health Administration [ADAMHA] supports research regarding the psychological responses to various disaster situations including chemical waste crises; for example, the situation in Missouri where dioxincontaminated waste oil has been the source of extensive environmental contamination.

Since 1980 we estimate that funding for environmental health research has increased by $70.62 million. Specifically: $348 million was funded in fiscal year 1980; $363.8 million in fiscal year 1981; and $385.4 million fiscal year 1982. Estimates for fiscal year 1983 are $399 million. Estimates for fiscal year 1984 are $418.7 million.

Other environmentally related activities.—In the Department there are other environmentally related activities that are important. DHHS has health related responsibilities mandated by the Comprehensive Environmental Response, Compensation and Liability Act (Superfund). The Agency for Toxic Substances and Disease Registry [ATSDR] has been established in PHS in response to this mandate. Agency staff provide assistance to the Environmental Protection Agency in documenting human exposure and adverse health effects in populations near waste sites. They have looked at many of the EPA-designated priority hazardous waste sites to determine if there is evidence of exposure and disease that could possibly be related to those dump sites. NIOSH is also working with EPA on the design and monitoring of worker health and safety plans at priority hazardous waste sites.

Agency interaction and coordination.—The Department is also pleased with the spirit of interaction between DHHS and EPA. A recent example is the designation of an NIEHS intramural scientist, Dr. John Moore, and an NIH grantee, Dr. Bernard Goldstein, to senior EPA positions. The central coordinating mechanism within the Department is the Committee to Coordinate Environmental and Related Programs [CCERP]. This committee serves as an important means for state of the art analyses, information exchange and provision of advice to the Department on environmental health, toxicology, and related programs.

Its membership includes representation from each agency within the Department supporting or conducting activities in this area. Representatives from EPA, OSHA, the Consumer Product Safety Commission [CPSC], the Department of Energy [DOE] and the National Science Foundation [NSF] are among its liaison members.

This coordinating committee has been functioning since about 1973. Another coordinating effort is the national toxicology programs which combines selected toxicological research and testing from resources from NIH, FDA/NCTR, CDC/NIOSH, ATSDR, and has as its major advisory committee the NTP executive committee which has on it the major health research agencies, NIH, FDA, CDC and the major health regulatory agencies, CPSC, FDA, EPA, and OSHA. This provides a direct mechanism for interaction between the PHS and testing and the needs of the health regulatory agencies.

The NTP annually issues a "Review of Current DHHS, DOE, and EPA Research Related to Toxicology." This long factual and comprehensive report I would like to submit to the committee. It has a summary of all of the toxicologically oriented research in those three major departments. It lists all of the chemicals being tested in those three departments and is, I think, a very useful source document.

The National Library of Medicine within NIH is an important component of toxicological research dissemination. It is a central source for the collection and dissemination of many aspects of environmental agencies. Recently as a result of increased information needs in carrying out its Superfund responsibilities, ATSDR has asked NLM to expand its toxicology data base to include additional chemicals and additional types of data available on each chemical.

Further, information generated by Department researchers is being utilized by the environmental regulatory agencies. OSHA in its recent notice to revise occupational exposure standards to ethylene dibromide [EDB], cited NCI and NCI/NTP conducted carcinogenesis studies as evidence of the potential for EDB to induce cancer in animals. In regulatory notices, EPA also cited an NCI chronic animal study in its assessment of health risks from EDB exposure. Another very recent example is EPA's and OSHA's announcement of a join call for information to consider regulation of 4,4′-methylenendianiline [4,4′-MDA]. They relied on the National Toxicology Program conducted studies that found the substance to be carcinogen in animals.

In conclusion, the Department of Health and Human Services has a variety of mechanisms in place to address the problems associated with the identification of hazardous substances in the environment, to determine the mechanisms of action, to develop means to reduce their damage to human systems, and to provide this basic information to the regulatory agencies. By January 1985, NIEHS will have completed a Third Task Force on Research Planning and the Environmental Health Sciences. With these efforts the Department will continue to make progress in charting the research direction of the environmental health sciences.

I will be happy to answer any questions you may have.

Senator **Durenberger**. Thank you very much.

Dr. Peck.

STATEMENT OF DR. DALLAS L. PECK, DIRECTOR, U.S. GEOLOGICAL SURVEY

Dr. PECK. It is a pleasure to be here this morning, Senator.

I am Dallas Peck, Director of the Geological Survey and I represent the Department of the Interior as Science Adviser to the Secretary.

I have with me this morning Dr. Richard Smith, Associate Director of the Fish and Wildlife Service and Mr. Philip Cohen, Chief Hydrologist, U.S. Geological Survey.

Much of the Department of the Interior's environment-oriented activity involves the issues of acid precipitation, toxic substances in the environment, and hazardous waste disposal. These issues cross bureau lines in the Department and also involve many other departments. For example, acid precipitation studies not only involve the Department of the Interior, but other members of the Interagency Task Force on Acid Precipitation. Environmental research is carried out at the level of about $100 million in the Department and involves every bureau. Time does not permit a full description of all of the programs, but I will describe a handful of the more important ones.

For the last several years the National Park Service has conducted an intensive air quality program. The goals of the program are to determine the relative sensitivities of the park vegetation to specific air pollutants; the level of trace elements and pollutants in air, soil, and vegetation; and whether air pollution effects are impairing the structure and functioning of the park ecosystems. In addition research is being conducted to determine air pollution concentration in park areas lacking air quality monitoring data and to identify source regions of emissions which contribute to existing air pollution.

The Fish and Wildlife Service, among other important environmental research activities, conducts research on contaminants and their effects on the Nation's fish and wildlife resource. The program objectives are to: Conduct applied research studies to identify and provide scientific information on fish and wildlife populations and ecosystems of high Federal interest and concern that are adversely affected by contaminants; to recommend corrective measures and/or management alternatives to reduce the exposure of fish and wildlife to environmental contaminants; to develop, maintain, and transfer ecological information to Federal, State, and private users to address fish and wildlife habitat and resource issues of national and regional importance, and to minimize and mitigate the effects of development on those resources; and to provide technical assistance and training to resource managers and other decisionmakers who use ecological information and tools to effectively manage fish and widlife resources and their habitats.

Some of the recent research outputs from the program are:

Identification of some acute and sublethal impacts of agricultural chemicals, heavy metals, and other hazardous materials to fish and wildlife. For example, the correlation between bent backbones and chemical stress was developed by the Fish and Wildlife Service.

Identification of the impact of oil pollution on fish, waterfowl, sea turtles, and other vertebrates has been important in assessing the effects of oil spills.

Investigation of the pathways by which contaminants affect fish and wildlife species; that is, the routes of bioaccumulation.

Service research has been instrumental in the documentation of impacts of acid rain on the fish population of lakes in the northeast central States.

The Geological Survey is active in several areas of the national acid precipitation assessment program. As lead agency for atmospheric deposition monitoring, the Survey coordinates a nationwide network for monitoring wet and dry deposition. In addition, as part of its research program, the Survey conducts hydrologic research in several calibrated watersheds to quantitatively describe the effects of acid precipitation, and monitors stream and lake composition in sensitive areas as part of an early warning system for detecting the effects of acid precipitation.

In studying acid rain, the Survey has found that trends in sulphate and alkalinity concentrations in streams across the Nation correlate with reported regional emissions of sulfur dioxide. In the Northeast, sulfur emissions have decreased and stream data show a slight decrease in the acidity. In the other regions of the country, sulfur emissions have increased and stream data show a slight increase in the acidity.

The Bureau of Mines carries out environmental research in such areas as health and safety, mining technology, and minerals and materials science. A recent noteworthy achievement is the development of a new and intensive method of reducing acid mine drainage.

In fiscal year 1982, the Survey established a toxic waste ground water contamination program to focus research on the effects of land use and waste disposal on ground water quality. The program objectives are to provide Earth-science information needed by resource managers to mitigate the effects of waste disposal, storage, and spills on ground water systems, and to improve future waste disposal practices. To fulfill this purpose, the Survey is conducting intensive research into the physical, chemical, and biological principles governing ground water contamination. Much of this research has focused at selected disposal sites where laboratory and analytical findings can be applied and evaluated in the field.

We are conducting regional and national appraisals of ground water quality and we are assisting Federal and State agencies in the development of guidelines and standards for managing the disposal of hazardous wastes.

To insure that lease development on the Outer Continental Shelf occurs in an environmentally sound manner, the Department has spent over $335 million on environmental and socioeconomic studies in the past decade or so. These studies have covered every stage of offshore leasing, drilling and production including such topics as marine mammals, shellfish, oil spill risks, air quality, social and economic impacts and changes in biological communities around drilling rigs. As a result of the pre-lease studies, we have developed special stipulations and other mitigating measures to respond to concerns unique to each lease offered. In addition, site-specific stipulations are attached to each lease to add further protection for important biological resources. Finally, each Outer Continental Shelf facility is inspected to insure that the environmental stipulations are suitable and correctly applied.

This has been a brief overview of the range of environmental research and development activities in the Department of the Interior. For the record, I am providing a written statement on the environmental research and development activities within a number of Interior's bureaus. I am also prepared to provide the subcommittee a representative sampling of related reports. A summary of the funding of the Department for environmental research and development over the last 5 years and for fiscal year 1984 will be provided to the committee in a few days.

We would be happy to respond to any questions that you have.

Senator **Durenberger**. Thank you very much.

My first question of all of you relates back to, I think, part of the opening statement. I guess what I am getting at is, how do we make the decisions about who is going to do what and how much money they are going to spend on it? I am impressed, but I haven't had time to read through your statement, Dr. Peck, at how involved USGS is. I thought all you did was do aerial mapping and tell us about geology and all of that sort of thing. But did you say you are the lead agency on acid precipitation monitoring?

Dr. **Peck**. Yes, actually the largest division in the Geological Survey is the Water Resources Division, which has a budget of about $200 million a year and a staff of about 4,000. Many of its activities are involved in water quality as well as water quantity of both surface and ground water. Many of its programs are related to environmental matters.

Senator **Durenberger**. I've gone through the rest of your program and you mentioned ground water and obviously there is a concern for the water as well as the impact of coal banks, particularly coal extraction, and the impact that is going to have on surface waters and streams. Obviously, if the Secretary wants to move strongly on OCS, you are going to get on that one.

We go on, and on, and on. I am just curious to get the reaction from all three of you and, in general, a sense about how we in the Government make decisions about setting research priorities. I don't want to deal too much with the interrelationship because you all make it sound like all you do is spend your time going to meetings with each other. I am sure there is probably much too much of that. What is your reaction, as the professionals, to how we go about making decisions about what are the priorities and what dollars ought to be committed to it? I will start with either of you.

Dr. **Peck**. Basically that is a political decision anyway, Senator, and the administration and Congress set certain priorities. For example, there is the current concern about acid rain, and so, for our bureau and many others, expenditures for research in acid rain have increased over the last several years.

There has been growing concern, I think, throughout the Nation regarding ground water contamination and, again, we have shifted our emphasis to programs aimed at that problem over the last several years.

Senator **Durenberger**. Are you spending most of your money in-house?

Dr. **Peck**. Yes. We do.

Senator **Durenberger**. All of it?

Dr. **Peck**. We have in various programs small outside grants. In our earthquake program, that is a substantial part of the program. Recently, the Congress directed us to assume direction of the Water Research Institute which constitutes a university resource in the water field.

Senator **Durenberger**. The earthquake program, is that the one that is going through the National Science Foundation?

Dr. **Peck**. Both we and the National Science Foundation have major earthquake programs and support research at the universities in earthquake prediction and the research on the fundamental mechanisms of earthquakes.

Senator **Durenberger**. Most of your money, $100 million?

Dr. **Peck**. Of our total budget, which is about $500 million, less than a tenth goes for university grants and contracts.

Senator **Durenberger**. Dr. Rall, would you like to respond to my first question and then anything else?

Dr. **Rall**. Yes, I would be delighted. We do attend a lot of meetings but I have got lots of scientists and different disciplines, you have to talk to them. That is the best way to do it. In the Public Health Service there are many ways of setting priorities and setting priorities is developing the information that is necessary then for an effective interface between the technical scientific people and the political people who make the dollar decisions and the regulatory decisions. So what I am talking about is how to get the best most up-to-date science. Within our institute, the National Institute of Environmental Health Sciences and this is true of the other areas within the Public Health Service, we have an advisory group and our appropriations subcommittee has about every 3 or 4 years asked our advisory group to organize a review of human health and the environment, some research needs.

This came out in 1977. We are currently initiating a new review. This gets together the best scientists in the country, scientists from the academic sector, from the industrial sector, from other Federal agencies that look at research needs and put together a report which we use, which our grantees use, which hopefully Congress and other political bodies use. So that is one way of trying to set priorities.

The national toxicology program was developed some years ago because there were toxicological efforts throughout the Department that seemed to be unrelated one to another. The main purpose of NTP is to get the right scientists talking to each other so that there is only intentional and useful duplication, that gaps are filled and so forth. The NTP has, as I mentioned in my first statement, we set up in part to provide an easy channel of communication between the health regulatory agencies which need the data and the health research agencies which produce most of the data. And I think over its 4 or 5 years it has worked very well indeed.

I think it is important to realize that scientists can only deliver what is deliverable at the state of science. That is where some important discussions come in between the scientists who want to provide the information and the political appointee, the regulator, who has to take some action. I think we have learned a lot over the last 5 or 6 years. I must say personally I think Mr. Ruckelshaus was superb in understanding the importance and the difficulty of this interface and I look forward to working with him in the future.

Dr. Riordan?

Mr. **Riordan**. I think in some ways our program is distinct from the others in that the majority of our program is applied, means that we almost have to ask two questions. We have to ask: Within a limited budget, which areas should we put our research money in from the point of view of the policy needs of the agency—which is a tough decision for the agency? and then a related question, Who can best do the work? Do we go to other agencies and ask that they do the work, or do we have the skills in-house to do the work, or should the work best be done with a university through some kind of extramural arrangements? I would like to say that this is a very systematic, and formalized and effective system but I really can't say that. We constantly, as Dave said, try to work on that because it involves a tremendous amount of communication between the technical people in the regulatory offices who are very informed, read the literature, they know what is going on in terms of the scientific community in other agencies, in our own and in the university community as well as our own scientists in our labs.

There is a very strong bottoms-up kind of component to the program that is built upon continuing scientific awareness on the part of the people who participate jointly in making decisions and reading that literature. Of course that bottoms-up process is then modified through the management and policy decisionmaking that is necessary before you come up with a budget.

I think, in general, the issues are raised. We know when it comes to a major initiative, we discuss whether a DOE laboratory, or NIEHS, or CDC, or NIOSH is the appropriate agency to do it, try to come up with as reasonable a decision as we can. It is not a perfect system but we certainly pay a lot of attention to it, Senator.

Senator **Durenberger**. Let me ask all of you then a somewhat related question which gets to the matter that I raised earlier about long-term commitments to research and development and, clearly, I, as well as anyone in the room, understand the political problems that we all have in responding to what has been on the front pages today. But one of my concerns, and maybe you can tell me that I shouldn't be concerned about it, is that you don't commit adequate resources from time to time to the long-range effort to solve these problems, knowing that some new knowledge is going to come along and throw you off course. It seemed to me there is some tendency toward bureaucracy in your effort, in other words without picking on USGS, but to use it as an example, you have in effect bureaucratized the research and development effort, largely in-house, plus what you can gather from some other people. And to a degree in other agencies it seems to me that that happens.

From some of the testimony I can recall from the June hearing, there is a somewhat substantial shift in emphasis away from colleges and universities into our national labs, and to me that is sort of, I will call it, a bureaucratization of research and development. People have to know where you are going to be 2 or 3 years from now or even 10 years from now. If you can't make long-range commitments to this larger community called the United States of America and all of its components, then it strikes me that you tend to go inside an agency or inside something you have control over.

Having said all of that, I hope I have made my question clear which is again to ask you, in other words, for your professional comment on whether or not there is perhaps a little bit too much bureaucratization of the R&D process and it ought to be a little more open to what I might call outside influence. It obviously was not meant as a demeaning phrase.

Dr. **Rall.** I would like to answer that because I think I have a very good answer, that at least at the National Institutes of Health we understand the problem of a small group of Federal employees becoming more and more ingrown and for that reason, most of the NIH money, about 80 percent of it, goes out primarily to investigatory initiated research projects primarily at universities.

And in fact, in most of the major developments in the environmental health field have come from universities, from scientists who have their own research ideas, get them funded from primarily NIH but certainly other areas, and these funds are generally for 3, 4, or 5 years worth of support. So that they had a sense of a long-term commitment from the agency. And this at least to my way of thinking is still the cornerstone of the research process.

At NIH we had extramural research programs which in some ways are like their counterparts in the university but also in some ways must do the more applied research that Dr. Riordan talked about.

Within the national toxicology program, we do a moderate amount of testing of chemicals. Most of that is done at contract laboratories because the workload fluctuates and it is much easier to phase out a contract rather than try to phase out 100 Federal employees.

But in our testing program, the selection of the chemicals is a process where there is great opportunity for outside input. We have public meetings where people are invited to comment on chemicals that ought to be tested and we have an outside board of scientific advisers which is largely academic scientists who also advise us.

So we are really concerned about what you say and we have tried to get the universities, the medical schools to be a major participant in this whole activity.

The green book will largely be written by academic scientists.

Dr. **Peck.** We have a mechanism for getting other viewpoints as far as research priorities and research direction. Half of our water resources program is a 50/50 cooperative program with 800 State and local cooperators in every State of the Union. And the research projects that are carried out are jointly agreed to and jointly funded by the local cooperator and by the Geological Survey. That puts us in touch with what the real problems are and with some of the opportunities.

Senator **Durenberger.** You also have, if I can use my own example and I hope it isn't an example of the way the USGS operates, but Matt Walton out in Minnesota, obviously because of the quality of the person, is also an integral part of what goes on in my State, both in the private sector and in the public sector.

Is that typical of the way USGS operates?

Dr. PECK. That is right. We work very closely with Matt. He has been pounding on us for several years to do more aeromagnetic surveys in Minnesota. It is very worthwhile.

We are starting several projects with him this year to expand the aeromagnetic coverage of the glacial drift.

Senator DURENBERGER. Dr. Riordan, do you have some general comment?

Mr. RIORDAN. I would say for a long time the majority of our budget has been devoted to extramural work. We have certain areas within our program in the past where I think we exceeded a 50/50 ratio of extramural work to in-house personnel. We really didn't have enough qualified people even to service the project offices and provide good oversight to extramural programs.

So I think we are in pretty good balance right now, I think, in terms of our extramural versus in-house. This issue about DOE laboratories that has come up specifically on the acid rain program, I don't know if you saw that comment or not from the Robert Hugh Committee, that he viewed our acid program in Boston last summer and it is true that a good portion of that acid rain program is in DOE laboratories. But there are some very real reasons for that. One of them is that the money is devoted to large scale, applied, multidisciplinary efforts, either field or laboratory efforts, requiring managers to mobilize people on relatively short notice. That, I think, was a problem that people faced and so the research managers in the field chose the DOE laboratories in those cases because they really were the best way to go.

Senator DURENBERGER. I am going to have to dismiss the three of you soon so that we can finish this morning. But I wonder, Dr. Rall, you and some of your experts here, again trying to recall some of the things that came up at the June hearing; let me just ask you a general question and use either pesticide as an example or to use any NIOSH as an example.

The problem of access information lies only in the private sector. I recall from my own private sector days in the Specialty Chemical Co. looking at a NIOSH request for information as the lawyer saying, well, we don't want to give them that kind of information. We will violate prospectively some proprietary information, et cetera.

I recall we had a little bit of a debate here with some of the people, particularly from the chemical companies about how we go about the process of accessing the information. Pesticides, I think, gets more complicated because we at the Federal level, seem to be organized all over the place to deal with the pesticide issue.

I guess I have got some jurisdiction over that in this subcommittee but it is also in Agriculture, Interior, and Lord knows where else.

Perhaps you could, as a concluding comment, address yourself to the problems or the opportunities that we have in trying to work out access to information in the private sector.

Dr. RALL. I wish I had some words of wisdom. I personally feel that scientific research data on health and safety matters should be in the public domain. But that is only my personal view.

I certainly understand the issue that if a company spends many, many dollars and we expend literally millions of dollars to show the safety of a chemical, it really in many ways creates a very unfair decision if it is forced to divulge that information so a separate company can come in and have a free ride and start selling that chemical without doing the good-faith earnest toxicology studies that the first company has done. But I really also have faith that the legal system in this country ought to be able to manage a way to provide an assurance that the company that produces the data can let it be looked at by outside experts and still protect it from infringement by another company and I earnestly hope that that is what will happen.

Senator **Durenberger**. Thank you, all three of you. We have questions that we will be submitting to you and we would appreciate your taking the time to respond to those questions.

Thank you for your testimony.

We plan to have Dr. Chris Bernabo, executive director, National Acid Precipitation Assessment program to present his testimony and then I will call up Dr. Edington, Dr. Bridgewater, and Dr. Ostenso after that as a panel in much the way we did the first three witnesses.

Dr. Bernabo, why don't I call on you and if you have anyone to accompany you, feel free to do so.

STATEMENT OF DR. CHRIS BERNABO, EXECUTIVE DIRECTOR, NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM

Mr. **Bernabo**. I apologize. We tried to get here an hour early to set it up but it didn't work.

Senator **Durenberger**. All right.

Go ahead.

Mr. **Bernabo**. Again, I apologize for the confusion getting started. I appreciate the opportunity to be here today to discuss the National Acid Precipitation Assessment program.

The National Acid Precipitation Assessment program is the statutorially mandated effort that pulls together the acid rain research of various Federal agencies and attempts to put that in a long-term comprehensive program to improve our information on acid deposition, particularly for use by policymakers.

The national program was established by the Acid Precipitation Act of 1980. This legislation specifically set up an interagency task force to manage the program, with a three-way chairmanship between the National Oceanic and Atmospheric Administration, Department of Agriculture, and the Environmental Protection Agency.

The program includes basically all of the Federal entities with some interest in acid rain, the Council on Environmental Quality, Departments of the Interior, Energy, Health and Human Services, NASA, National Science Foundation, and others.

The act also provided for a special leadership role for the National Oceanic and Atmospheric Administration relative to this program as had been the case in the two previous programs, national climate program and national marine pollution program, which are similar type efforts.

The task force which manages the acid rain effort has a number of responsibilities. The first of those was written into legislation and is to develop a long-term plan for this national effort. That plan was developed with considerable input from scientists around the country and the world as well as a public review by the various interest groups and was submitted to Congress in 1982.

The task force is also responsible for a number of other aspects beyond the planning, such as the implementation of the program. This requires coordinating of the efforts. We heard from the previous witnesses this morning about their portions of the national program. All of these efforts had to be coordinated into a comprehensive effort.

One of the unique aspects of the program is the interagency budget process. Unlike the usual process of each agency going in competitively with their budgets, we start with a single overall resource base which is allocated for acid deposition, work with various scientists within and outside Government, and set overall priorities and goals. Then from there we determine who is best suited to do it. This slide shows the overall structure of the budget. You have copies at the end of the testimony with budgets for 1982, 1983, and 1984, showing the agency participation in research areas.

We are also providing an online inventory of all of the Federal research. We are working with the private sector to have inventory for private sector research. We are also going out and pulling information from the States so there will be a single data base developed for the people within and out of Government.

All of the research in the country contributes to the program. There are substantial efforts in the States and private sector in acid rain. We have held a number of meetings and joined with a number of people to coordinate our Federal effort with those efforts.

Another aspect of the task force responsibilities is the fact that we have an annual reporting requirement to the President and the Congress to determine what the state of the science is, what the progress is being made and the outlook.

We issued an annual report in 1982, the first year in which we had a budget in the program, describing the state of the science and progress. We will be issuing our 1983 report sometime after January 1984.

Beyond that, there is also a number of research programs going on outside this country. Most notably the Canadians have about $20 million a year in research going on.

We have met several times with our Canadian counterparts and have a number of joint projects underway, developed proposals for the future projects, and have had very excellent cooperation with them.

We are expanding our cooperation also with the Europeans who have been studying this issue for quite some time. We are drawing on the full range of information that is available. In terms of how the task force is organized, the task force itself serves as a board of directors for the program.

We have three joint chairmen and a series of task groups. The task groups include program level scientists who understand the nuts and bolts of what is going on. They respond to the guidance from the task force, which determines overall direction. For instance, we felt there needed to be more emphasis in the forestry area. We went down to the people who know most about what can be done in the forestry. They developed a plan which will come up and be approved by the task force. We have a program coordination office staffed by people from different agencies and that serves as a focal point for the management of the program and dissemination of information. We have a Research Coordination Council which includes the leaders of all the technical task groups and insures there is proper coordination between the various disciplines which is necessary, of course, for pulling information together to assist policy development.

You have heard some of the agencies mention their lead roles earlier here today. You can see the various areas ranging from natural to manmade sources on down to atmospheric processes, monitoring, effects on the aquatic and terrestrial systems, effects on materials, control technologies, and assessments. The lead agencies are listed along with them on this slide.

Each of these areas has multiple agencies involved. We have designated a lead to one agency to coordinate the activities. In these various areas, for instance, things like health effects are dealt with in the aquatic and terrestrial areas respectively for drinking water and the food chain.

This covers the whole gamut. Particularly interesting is the fact we have an assessment group that tries to pull together the technical information in terms of synthesizing the various pieces of information.

I really don't have time to go over all of the research in the various areas but I wanted to hit some highlights of the types of things we do.

In the atmospheric area, of course, the major question is the relationship between the emissions and the deposition of the materials somewhere downwind. There are a number of activities going on already, both field and laboratory experiments.

Again, some have been alluded to earlier today. One of great interest going on now is the cross-Appalachian tracer experiment [CAPTEX] which we are conducting jointly with the Canadians. We are releasing inert gas in the Ohio Valley and tracing this with aircraft and ground monitoring stations to examine the flow under different meteorological conditions. A similar release will be made in Sudbury, Ontario.

This does not answer all the questions. It will help us verify the models and determine the flow. We still have questions in terms of the chemistry which must be dealt with.

In the area of deposition monitoring, acid rain is a misnomer. We are dealing with acid deposition, acid deposited in a number of different forms, dry and wet. In the wet area, we are quite well off in terms of our ability to measure it. In the dry, we are not, and extensive efforts are being put into developing techniques for routine monitoring dry deposition. This is crucial to understanding what the inputs to the lakes and ecosystems are.

Wet deposition is under the lead of the U.S. Geologic Survey, we have set up the National Trends Network. You see here on the map the solid dots are existing sites and the other open circles are sites being put into place, about 150 sites nationwide.

Despite the fact that it looks like a shotgun approach, extensive studies were put into the design of where these sites are relative to covering all the major ecoregions in the country; particularly sensitive areas. So we can look at the patterns over the country. We hope to maintain this network for a long period. It solves the problems of the past, when inadequate data exists.

Senator DURENBERGER. Before you move on, spend a minute or two telling me how you came up with this because it does look like a shotgun approach. There are those who perceive that there shouldn't be anything west of the Mississippi.

Mr. BERNABO. There is a greater density of sites east of the Mississippi. That is because of the gradients there in the current deposition of acids. We felt we needed many sites to determine if there is movement in those gradient as conditions change.

We also used the U.S. Forces Service classification of ecoregions of the United States and for each of the ecoregions we put a number of sites in those ecoregions, equal to the aereal distribution of those regions.

Beyond that, we looked at the coverage in terms of States to make sure there was effective coverage geographically. So a number of different superimposed factors were optimised.

Senator DURENBERGER. Is that white dot a source and the little squares are something else?

Mr. BERNABO. No, I am sorry. There were some preexisting monitoring networks prior to this program. We have, rather than reinvent the wheel, gone out and looked at the preexisting networks and those are the white dots, existing sites which fit into the general distribution and which met our site criteria.

We sent teams out to each one of these sites to examine the local situation to make sure it was meeting the protocol standards for the National Trends Network. Many of the networks in existence were volunteer networks. For example, if someone didn't want to do any monitoring in Arizona, there was no site in Arizona. From our standpoint we may need a site in terms of the design plan. We are going out and putting in the sites where none yet exist. The open circles are sites which go into effect this year.

Senator DURENBERGER. Are these all receptor sites?

Mr. BERNABO. Yes, these are all monitoring sites at which wet deposition is monitored on a routine weekly basis. Also notice there are two sites in Canada. Those are jointly sited with the Canadian networks for intercomparisons so we can draw maps of the full continent.

Senator DURENBERGER. Are they doing much more?

Mr. BERNABO. They have a smaller network but a good network too, I believe, of about 60 sites. We have 150. We have been cooperating very routinely with then. Obviously the problem doesn't stop at the boundary. We should look at it on a continent-wide basis.

In terms of water resources, the area where we have the greatest concerns in terms of demonstrated impacts, one of the things which was not known prior to the program is what is the extent of the resource at risk? This is a map of sensitive surface waters in the United States. The darkest areas you see are the most sensitive, based on some 2,500 water surface samples showing where regions are particularly sensitive to acid deposition. We also have gone in and done much more detailed work. The next step is to determine which ones in fact have been impacted. We look at their biology. This is now under way and will be completed this year.

We will have, on a nationwide basis, the first look at where potentially sensitive areas are and the sites currently damaged. The next year we will focus more on the mechanisms of the problem, expanding our ability to predict the problem, to examine how a given watershed responds, some very complex issues. There are some models to predict changes in the watersheds, again important for policymakers to know how rapidly this change is occurring. We are moving more into the methodological studies looking at the lakes.

In the terrestrial area we are looking at crops and forests. We are particularly concerned about the forest. The question remains to what extent acid deposition is related to forest die back, the Northeast, and a number of studies are looking at that. We are also looking at the long-term history of the various forests and their productivity. In terms of crops we are focusing or emphasizing crops of major economic value, such as soybeans and corn. In addition we are looking at structural materials, buildings, and cultural monuments. We are completing an inventory now in the Eastern United States of the potentially susceptible materials to determine how many resources are at risk.

Finally, what we will do with all of the information is try to pull it together. Obviously there is information from many different sources. When there is a crucial mass, if you will, of information, we'll make assessments of and safe statements of more than piecemeal aspects of the problem. We are working on our 1985 damage assessment, at which time we think the first major assessment nationwide of the damages is possible. To the extent possible we will define damages in economic terms and possible ecological and other terms, defining the damage that are currently related to acid rain.

We will also be determining and explicitly stating where the uncertainties remain in terms of these damages. We have this major assessment under way now and scientists in all of these areas are pooling their information on acid deposition.

Finally on the budget area, there is on page 15 of my statement a chart showing the funding of acid deposition research throughout the Federal Government from 1980 to the present. It has between 1980 and 1983 been doubled from $11 million on various piecemeal efforts before the national program existed out in 1980, to 1983, the past budget year when about $22 million was spent. The President's budget for 1984 requests a further increase to $27 million. Those resources are distributed in this particular slide showing the different research areas such as the aquatic impacts, smaller in amount terms, larger amount in deposition monitoring, to establish that network and maintain it, atmospheric processes in some of the other areas.

If you look at how the funds are distributed between the agencies, roughly 50 percent of the program is funded currently through the Environmental Protection Agency and more or less equal shares between the Departments of the Interior and Energy, NOAA and Department of Agriculture.

I might point out that one member of the national program, the National Science Foundation, is not shown in this core budget, although the National Science Foundation is sponsoring about $1½ million in acid rain research. That is a conscious omission. We felt that the dollars of the National Science Foundation represents a pool available for good ideas without the relevancy restriction we apply to all the other work. Such work can sometimes, in the long run, turn out to be the most important ideas. There is a pot of money to go with the novel ideas to see if they have scientific merit without having to apply the relevancy criteria. So our core budget is actually a conservative estimate of the funds for acid rain research. This is all in your copies of the written testimony.

In conclusion, we have had a very productive interaction between the agencies in developing the program. We are now finishing our second year of research under the national program and the foundation has been laid to rapidly increase our information base on acid deposition. I would be happy to take any questions.

Senator **Durenberger**. In your damage estimate, I take it from this presentation without having read your statement, that you appear to be largely in the damage business. Are you doing any analysis of the damage done by sulfur dioxide and NO_x apart from acid deposition? Is that somebody else's responsibility?

Mr. **Bernabo**. That is someone else's responsibility. We are dealing with the problem as of the point of deposition. That is explicit in the legislation that established us and also so we don't spread the resources too thinly. Obviously, scientifically they are linked and the control of these pollutants will have benefits beyond the deposition-related problems. We try to coordinate as best we can. In our assessments where we are looking at changing omission scenarios, we will factor in not just the benefits that may derive from reduced acid deposition, but obviously you have to factor the other benefits, whether it be visibility or the health effects to the extent one can. But those are studied in other programs, yes.

Senator **Durenberger**. Are you capable of telling us in what other programs?

Mr. **Bernabo**. I would probably defer to Courtney Riordan, some of the people here who have those programs under their jurisdiction to provide that. We could certainly supply the information.

Senator **Durenberger**. Let me ask you the question: Who is doing source inventory in the same manner in which you are doing receptor inventory?

Mr. **Bernabo**. There is a man-made source component to the national program which is led by the Department of Energy and includes input from EPA. We are producing inventories of the primary precursor emissions, namely SO_2 and NO_x and other pollutants which affect acid deposition. We are doing that as direct input to our atmospheric models. That inventory work is part of our program.

Senator **Durenberger**. Where are we in terms of developing reliable information, on being able to measure the amount of sulfur dioxide or NO_x from various sources?

Mr. **Bernabo**. We are improving and expanding the inventories that currently exist. There are some shortcomings. But I think we will be in fairly good shape in determining the source characteristics and strengths. The much bigger problem is developing the models capable of predicting where the emissions end up and in what form and what amounts. Of course that is crucial to decisions about control and right now considerable scientific controversy exists on that subject. But it is generally agreed that the current models for source-receptor relationships, have large uncertainties. For instance, the relative importance of local versus long distance sources is unclear, although both certainly contribute to the problem, as the National Academy of Sciences and others who have looked at this point out.

The current generation of models have factors of two to five uncertainties, which is not adequate for the job. We are hoping to have models to provide much better guidance for the policymakers. We can make gross generalizations now but clearly we are concerned about predicting deposition accurately for the sensitive regions where the impacts are likely to occur or are occurring.

Senator **Durenberger**. Do you have an opinion as to how long we can wait based on what you all already know about this situation to do something to apply an answer to the problem?

Mr. **Bernabo**. There is no compelling evidence I know of, no firm evidence that we are about to sort of fall off the cliff; that is to say, suddenly everything is going to go awry. On the other hand it is fair to say in the aquatic area damages are occurring. We are not sure of the rate. But damages are occurring and will continue to occur. But the question of when we have enough information to act is a political question not a scientific one as you well know. In all of these difficult environmental areas, we rarely have the type of information you ultimately want, but it is also true that in the coming years the research we have initiated will increasingly improve our ability to understand and respond to the problem effectively. I think in the coming years progress will be quite apparent in terms of the improving of our tools.

Again it gets back to the question about long-term research. If we had been doing some of this long-term monitoring and research in previous years, many of the trends and answers might be available today. We didn't collect the data so we don't have that luxury right now.

Senator **Durenberger**. Where is the task force right now in this whole effort by the Administrator of EPA to formulate a national policy on acid rain? One of these days we are going to be doing something with the Clean Air Act and we are also doing the same thing with clean water. Some people on this committee are anxious to at least start the process of addressing the problem at the source. Does the task force have a specific role in providing this administration with what the position ought to be on source restraints of one kind or another?

Mr. **Bernabo**. We do not have a policy determining role. In fact that is explicit in the legislation. The officials even involved in various agencies are the research management officials, not the regulatory officials. So we are not determining policy but on the other hand we are in fact providing basic scientific information. There is another task force which the administration has established to develop policy. We interact to provide the science but we don't make the policy decisions. That is obviously up to the other groups, which includes another cast of characters. We are providing the information base to both the Congress and the administration.

Senator **DURENBERGER**. Your statement says the task force functions as a board of directors for the national program. How often has the board of directors met since 1981?

Mr. **BERNABO**. They meet about four times a year, sometimes more frequently. They are the highest level representatives. Dr. Courtney Riordan, for example, is the EPA cochair. The task force members are usually at the Assistant Administrator or Assistant Secretary level and NOAA and the Department of Agriculture share the chairmanship with EPA as designated in law. So people at that level meet typically about four times a year with the whole group. The three cochairs themselves meet more frequently than that, as need arises.

Senator **DURENBERGER**. So the Administrator of EPA or the Secretary of Agriculture is not a member of that?

Mr. **BERNABO**. No. The people at the next level down, the Assistant Administrator level. It is generally the highest ranking official responsible for research in the agency because this is a research program.

Senator **DURENBERGER**. Let me ask another question and you appropriately earlier referred to the fact that there is a difference between politics and what this task force is supposed to do. But to what degree does the task force perform an educational function? In other words, there are some of us and I alluded to this in the previous question, that see this as a national, not a regional problem and yet there seems to be some tendency for a lot of people in this country and obviously a lot of politicians to see it mainly as a regional problem because there are certain regions of the country which is more serious than others.

Does the task force have as a charge performing any kind of a national educational function raising the level of understanding of people all over this country to the potential seriousness of this problem regardless of what state?

Mr. **BERNABO**. I wouldn't say that we have a formal program of that nature, but I would say we do perform that function. For instance, our annual report in 1982, we get requests for that, not only from officials here in Washington, but also from high school students writing term reports. I go around the country speaking to a number of audiences and States all over the country, describing to the information. There are as you know now a number of programs, such as in California, Wisconsin, and Minnesota, and Colorado has a prospective acid rain program. I have been actively participating with all those States in trying to develop awareness and coordinate productive interaction with the Federal Government.

I think a number of the things we publish and develop do in fact perform an educational function. We also sponsor a number of workshops to get the general public, opinionmakers, people in the private sector, environmental groups and so forth to discuss the status of the science and the concern that they have. So yes, we are performing that function although not as a formalized role.

Senator **Durenberger**. If I read the newspapers correctly and accurately, the President hasn't addressed this issue yet. He used it around the appointment of Mr. Ruckelshaus. I assume he didn't write the statement, somebody else did. You correctly alluded to the fact that there is a Cabinet-level task force of some kind. If we were to raise the level of national cognizance to the problem above the level of those that already recognize it, and come to you for information, isn't this the most logical kind of an interagency group to bring information to the country on the part of its government? Is there something else like this that is more meaningful?

Mr. **Bernabo**. There are a number of other efforts in the United States. We just had a meeting week before last. There are a number of other information disseminating organizations, such as the Acid Rain Information Clearinghouse. It is an organization with a wide range of sponsorships, including private sector groups, the State of New York, and Province of Ontario. They disseminate information. We use them as one of several outlets for our information. In some ways it helps us because they can do it on a cost recovery basis with the materials they put out. They have no position on the issue, they just put the information out in an honest way. There are also other groups, like the Acid Rain Foundation which work to educate people about the issue. The meeting we sponsored last week, trying to get all the Federal, private sector and independent organizations to discuss how we get that information out both the public and the decisionmakers, not only at the national level but the State level, even local level. So there are extensive efforts which we are coordinating with in accomplishing that.

Senator **Durenberger**. Are there any improvements we can make in the research program for acid precipitation?

Mr. **Bernabo**. I think we do face frustrations due to the very complex nature of the issues. It is hard to really cover the whole thing. We had to set up priorities. We draw upon peer review panels and others to look at what we are doing and examine not only how we are doing, but also the resource we are using, whether it be the National Labs, universities or the Federal agencies and whether we are asking the right scientific questions. We have gotten good marks on asking the right questions. But people in the universities feel we haven't given them as big a share of the pie, if you will, as they might feel appropriate. That is an issue discussed before today which is common to the inertia inside bureaucracies. But I think we are addressing the best way possible. Again it is frustrating because the demands of the policy debate far exceed the ability of the science to provide what is needed. We would like to know right now what is the extent of the damage to forests, but it takes so long to grow a tree and study its response. You can't move that up too much. We are accelerating research to the maximum extent you can and still do good science, which sometimes is not quick enough to satisfy the policymakers who may face making a decision in the next session of Congress.

Senator **Durenberger**. Thank you very much for your testimony. We appreciate it.

Our last three witnesses, Dr. Charles Edington, Associate Director of Health and Environmental Research, Department of Energy; Dr. Albert Bridgewater, Acting Assistant Director for Astronomical, Atmospheric, Earth, and Ocean Sciences, National Science Foundation; and Ned A. Ostenso, Acting Assistant Administrator for Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

Thank you for being here. We will go in the order you are introduced.

STATEMENT OF DR. CHARLES W. EDINGTON, ASSOCIATE DIRECTOR, HEALTH AND ENVIRONMENTAL RESEARCH, DEPARTMENT OF ENERGY

Dr. EDINGTON. Thank you, Mr. Chairman.

I am Charles Edington, Associate Director for the Office of Health and Environmental Research. As you may be aware, the Department of Energy's environmental research programs are conducted basically by the Office of Energy Research which has the primary responsibility for biological research including research on the environmental issues associated with increased levels of carbon dixoide in the atmosphere. Other DOE programs are in the Office of Fossil Energy which supports basic and applied research and development to improve control technology and combustion or conversion processes to minimize the release of pollutants from fossil energy activities.

I would like to speak to each of these separately. The biological and environmental research program was created in 1947 as the Division of Biology and Medicine when the Atomic Energy Commission was created. For the first 28 years our focus was on radiation effects research. We developed a broadly based basic and applied multidisciplinary research activity which was developed to address the long-term health and environmental concerns associated with exposure to ionizing radiation.

In 1975, when the AEC was abolished and the Energy Research and Development Administration was created, now the Department of Energy our mission was broadened considerably to conduct a comprehensive health and environmental research program in support of all energy technology developments. We are not a regulatory agency. Our goal is to try and anticipate potential energy-related health and environmental issues that are associated with the various energy technologies that may be required to meet the Nation's energy and national security needs.

Basically our objective is to develop a data base which would allow us to reduce or eliminate any uncertainties which could constrain the utilization of the various energy resources when they are needed.

With our broad mission, it has been necessary to set program priorities. Today we continue to support our radiation effects research program. This research is to address the long-term late biological effects resulting from exposure to ionizing radiation. Currently, we support approximately 65 to 70 percent of all radiation effects research in the United States.

In addition, we are focusing our attention on health and environmental issues because this is a technology which conceivably will provide a large amount of our energy needs in the near to midterm. In this area, we are focusing attention on complex chemical mixtures and selected chemical compounds that may have health or environmental implications. Specifically we are addressing our research activities to the synthetic fuel processes. In addition we address specific short-term needs of the longer term renewable of energy technologies such as fusion, solar, and conservation options where there may be health or environmental concerns. We, like the National Institutes of Environmental Health Sciences, support long-term basic biological research activity to provide information on the structure and function of sensitive biological components and to obtain data that will allow us to interpret mechanisms of pollutant damage and repair.

In this way, we obtain data that are important for interpretation of pollutant effects and for extrapolation of effects from molecular, cellular or animal systems to estimate risks to human health.

Our basic concerns are to determine what late biological effects are produced from exposure to radiation or other energy-related pollutants. We would like to do this to determine whether or not cancer, genetic defects, developmental and reproductive changes are indeed produced by low doses of radiation or chemical pollutants. To do this, it is essential to find out what human health effects are produced as well as effects on ecological systems. It is essential that we identify the biologically active materials at the source—those materials that may be released to the environment, either in the work environment or to the general population environment. It is also important to determine how those biologically active materials move through the atmosphere or the terrestrial, or aquatic ecosystems and whether they produce an effect on those systems. Therefore we conduct a very comprehensive long-term research program which basically covers the emission from the source itself to the receptor and the effects on the receptor.

The products of our research are publications in the open scientific literature, the peer reviewed literature. These publications are available to both national, international organizations as well as technology program offices for their use in determining whether or not control technologies should be used and to make risk assessments that may have implications for human health. They are used also, especially in the radiation area, for litigation purposes for both the Government as well as the individuals who have brought suit.

Basically our information is transferred to user groups such as the technology program offices. I have here a series of documents that I would like to leave with you which would indicate how we determine the status of specific health and environmental effects or relationships to technology program activities. We use these status documents for workshop proceedings to help us to develop the research needs for the future. I think we interact with all agencies whose representatives are seated with me here today and who have been here today.

We work very closely both formally in interagency committees such as the Acid Rain Task Force and we interact informally and formally with the staffs of the various agencies. The fiscal year 1984 budget is $184 million for biological and environmental research and an additional $17 million for environmental research in the fossil energy program. These budget allocations are reasonably close to our fiscal year 1983 budgets in both programs.

That concludes my statement. I will be happy to answer any questions.

Senator **Durenberger**. Thank you very much.

Dr. Bridgewater.

STATEMENT OF DR. ALBERT L. BRIDGEWATER, ACTING ASSISTANT DIRECTOR, ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES, NATIONAL SCIENCE FOUNDATION

Dr. **Bridgewater**. Thank you, Mr. Chairman.

Listening to the questions that you addressed to some of the earlier panels I had the impression that you must have read our testimony. It deals in great detail with the long-term nature of environmental research and also for the need for the involvement of national scientific and scientists without strings.

Senator **Durenberger**. I haven't read it.

Dr. **Bridgewater**. I will not repeat it all.

I am pleased to have the opportunity to present testimony today, on behalf of the National Science Foundation [NSF]. The purpose of this testimony is to familiarize you with NSF's role in environmental science and our relationship to mission-oriented agencies which address our Nation's emergent environmental concerns.

To this end I first will define the NSF's overall mission, and then I will describe NSF's role with respect to environmental science. The National Science Foundation, as an independent Federal agency under the authority of the NSF Act of 1950, has the mission of supporting basic scientific research in order to maintain and increase the Nation's capability in scientific and technological areas.

The NSF itself does not conduct research. Instead we fund scientists in the private sector who perform research in academic institutions, at national facilities, or in isolated cases in industrial laboratories. Unsolicited proposals are received and evaluated through a peer review process involving both ad hoc reviews and/or review by a panel of experts. Awards are made based on scientific merit. The objective, methods, ultimate goals, and pace of the research all are determined by the scientists proposing the research.

NSF's role in environmental research is to foster development of basic understanding of the Earth, atmosphere, oceans, biological systems, and some aspects of engineering that affect or are affected by the environment. Timely resolution of today's environmental problems requires basic understanding of the primary phenomena involved. This understanding develops slowly through the long-term process of scientific investigation.

Individual investigators also may relate fundamental research being supported by NSF to application in research development or demonstration projects they may be conducting with other Federal agency support. For example, NSF-funded basic research conducted at Notre Dame University on sequencing batch reactors as an alternative to continuous-flow systems in 1976–78 led to an EPA-funded demonstration project using this concept at Culver, Ind., from 1979 to 1982.

As an agency devoted to fundamental scientific advancement, NSF does not fund programs directed toward specific environmental problems. NSF funding for projects related to environmental concerns is not differentiated into those portions of the research project which relate to an environmental problem and those portions which do not. For this reason it would be inappropriate to attempt to quote funding levels for environmental research directed toward problems. It should be noted that research projects which bear some relation to environmental concerns receive funding ranging from smaller project grants of $50,000 to large studies which receive several million dollars annually.

It should be noted that NSF has not experienced any significant impact resulting from cutbacks in EPA funding. Cutbacks on already minor EPA funding of oceanographic research resulted in a few investigators coming to NSF with proposals to compensate for loss of EPA funds. One example is the Marine Ecosystem Research Laboratory [MERL] at the University of Rhode Island. The facility was constructed in 1976 and initially was supported mostly by EPA funds. While the EPA cutback resulted in a slight increase of the budgetary demands on the NSF/OCE budget, it also has made a valuable facility more available for basic research on the chemical and biological dynamics of estuaries.

The first-order use of information generated by NSF-supported research is by scientists. Therefore, the primary point of dissemination is in the professional journal. One criterion in the peer review process is the effectiveness of the proposer in making research results available. However, where topical interests dictate, NSF, often in cooperative efforts with other Federal agencies, supports workshops, symposia, and publications that bring together scientists and those concerned with policy. A recent example illustrating such cooperation is "CO_2 and Plants: The Response of Plants to Rising Levels of Carbon Dioxide," AAAS Selected Symposium 84 (1983). Eight private and Federal organizations underwrote this particular conference. In addition, any reports resulting from NSF-supported research are sent to the National Technical Information Service for distribution to the public.

This concludes the National Science Foundation's testimony before the subcommittee. I thank you for the opportunity to describe NSF's programs.

Thank you, Mr. Chairman. I would be happy to respond to your questions.

Senator **Durenberger**. Dr. Ostenso?

STATEMENT OF DR. NED A. OSTENSO, ACTING ASSISTANT ADMINISTRATOR, OCEANIC AND ATMOSPHERIC RESEARCH, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Dr. **Ostenso**. Thank you, Senator.

First, I would like to introduce Dr. Lester Machta, Director of our Air Resources Laboratory. He is our expert on acid rain in case you want to ask questions that plumb the technical competence of an old geophysicist.

First of all, I should explain that research and development is widely distributed throughout NOAA. Most of it is in direct support of improving the delivery of NOAA services in both the ocean and atmospheric sector. Within the organizational element of the Office of Oceanic and Atmospheric Research, we do research that is more generic—for example, understanding processes—and less that is directly applicable to ongoing services. The Office of Research in turn is subdivided into three organizational components. One is the Office of Climate and Atmospheric Research, which organizes and sponsors large research programs, frequently global in scale and usually international, involving a number of countries and a number of agencies. It is through this office that we coordinated our effort to support the El Nino research with substantial participation of NSF's ocean programs and atmospheric programs of other agencies.

Telecommunication between the oceans and the atmosphere and its effect on forecasting climatic conditions is a major programmatic thrust of great importance to us.

The second organizational element is the Office of Sea Grant and Extramural Programs. This includes our undersea research program office. The thrust of this programmatic area is toward resource development and better use of our coasts and heritage to the extent that it substantially involves environmental resources and support of husbandry of the resources of our oceans and lakes.

An example in your own State, Senator, is the ongoing work to monitor the fate of mine tailings in Lake Superior. Understanding of the movement of these and other sediments is an important aspect of managing this major body of water.

Another example of such a program is the cooperative work between the Great Lakes sea grant colleges and our Great Lakes Environmental Research Laboratory, in trying to monitor and understand the effects of the PCB's and other synthetic organics in the Great Lakes. The advantage of this program and its outreach is that we can capture the diversity of talent needed to work on an extraordinarily complex problem and at the same time have a Federal laboratory with long-term continuity that extends beyond principal investigators and universities. Indeed it was scientists at the University of Wisconsin Medical School that did research showing PCB efforts on mice.

Finally, we have the Environmental Research Laboratories which is a network of nine major installations with some smaller satellite laboratories—literally a global network of field stations. Also six joint institutes participate.

Most of our acid rain-related air quality research is conducted in ERL's. The principal players are the Aeronomy Laboratory and the Air Resources Lab. Our specific responsibility for the Federal acid rain plan is natural sources, atmospheric transportation and deposition. The nature of the research we are conducting is sufficiently fundamental that we are beginning to understand how the broader environmental quality program intermeshes with the acid rain problem. One is that the ambient atmosphere is probably much more acidic than what was originally thought. Some of our monitoring stations have obtained some of the highest recorded acid precipitation.

For instance, we are realizing that the oceans play a much more important role in acid rain than we would have believed a couple of years ago. In fact, our two ocean laboratories are now major players in this effort. It seems that biogenic sources of sulfur and particularly in the Gulf of Mexico, play a very important role in ambient acidity.

We are also looking at the effects of alkalines or the absence of alkalines in the atmosphere as a result of paving of the roads and, in the western United States, going from a dry agricultural regime to an irrigated regime. Also we are realizing that there are complex photochemical interactions between NO_x and ozone, particularly gases that contribute to the ambient acidity process that we didn't understand a few years ago.

Through this program we are developing major sophisticated technologies measuring what is going on in the atmosphere and troposphere—the key to understanding the acid rain problem.

An advantage of being the last witness is that you can sort of pick up some of the threads of the discussion. I would like to skip to how we try and set our own priorities and how we try to manage ourselves. One aspect is that we are a disciplinary and geographically disaggregated collection of scientists trying to work together. Second, we get substantial participation by industry, Federal laboratories, and academic institutions. At headquarters level, we manage seven "product lines." These are research to improve our ability to observe and predict the weather; research related to air quality and to marine quality, including, by definition, the Great Lakes; our climatic research; solar terrestrial services research; marine observation and prediction research; and marine resource research and services.

Let me give you just one example of how we try to manage ourselves without going into details on the number of reviews and bureaucratic processes. We try to debureaucratize national science. We have specific procedures and processes we follow when we review our programs to insure that we get the broadest participation possible, and we of look at our product lines across organizational and budgetary boundary lines when it comes to addressing major problems.

One of the areas of marine resources that we are looking at is the potential of the newly discovered polymetallic sulfides at the ocean spreading centers. We had a series of cruises in which included both the U.S. and Canadian Geological Surveys, three of our laboratories, the National Ocean Service, and a number of academic participants, some of whom were probably there under NSF auspices.

Last January, we held a second in a series of symposia with industry looking at the research needed to assess the potential of this metallic resource, research needed to capture a "harvest," if you will—because minerals are probably forming at a rate approximating or exceeding consumption—and, third, the environmental impact of such a process and whether such a process should be undertaken.

Industry was well represented as were other major agencies—NSF, the Department of the Interior, and ourselves. So this is our effort to look across normal bureaucratic boundaries to try to manage our research and focus on issues of the highest importance.

With your permission, I will conclude my formal statement here and offer myself for any further questions you may have.

Senator **Durenberger**. Thank you very much.

Let me ask Dr. Bridgewater and Dr. Ostenso to comment, if you will, on the role that the Department of Energy is playing in research on the environment and/or health effects of a lot of the materials, whether nuclear or fossil, synthetic, fusion, solar, et cetera, that we use to power transportation, power manufacturing, change temperature and so forth in this country.

Is it appropriate, as we look at the Nation's energy future, to put a fair amount of research resources for environmental and health effects if we do it in the Department of Energy or can this be better done somewhere else?

Dr. **Bridgewater**. If neither one of us wants to, I will take the honor.

I think it is highly appropriate that the Department of Energy have a role in the study of how the environment affects the active programs. That they not have responsibility for, I think, studying the environmental effects would be a disservice to the country.

Certainly, you cannot turn to the academic community to go out and study all of the health problems. The agencies have to play a role where they have active programs.

Dr. **Ostenso**. I think my response would be that our appropriate role in research is probably a bit more toward the basic end of the spectrum.

One aspect of the fossil fuel burning, of course, is the addition of CO_2 to the atmosphere, but in the last few years we have become aware of other relatively important species which probably have an aggregate effect as important, if not more so, than CO_2.

Not only that, they have a longer residence time in the atmosphere. So I think our role is probably one of looking at the chemical health of the atmosphere more broadly than EPA's role in looking at the specific results of certain energy production technologies. But I should let Charlie speak to that.

Dr. **Edington**. Mr. Chairman, I think, of course, I am biased—I think that in the past the Department of Energy has demonstrated its great capability in anticipating problems, initiating the research required to resolve those problems, and developing a data base which has been very useful in the radiation area in developing human health risk estimates.

I don't think for any other pollutant, if I may use the term, chemical on otherwise, we have a data base that will allow one to do that. International bodies, that are reviewing those data, do indeed recommend risk estimates.

The standard setting is for the EPA on other organizations to do in the Federal Government. In the fossil energy area, for example—which we felt was an extremely important technology to look at—until 1975, there was no focused effort on any health or environmental issue relating to fossil energy effluents.

Starting in fiscal year 1976, we developed a very detailed comprehensive research program to, No. 1, identify the issues which we felt were important and to implement short-term research to try to determine what the biological factors were in effluents in the occupational environment.

In these documents, basically addressing synthetic fuel issues, we have developed information which has been extremely important to the fossil energy technology programs within DOE and also to the private sector, to demonstrate that there are certain chemicals which one needs to look at in more detail from a biological standpoint, from the standpoint of producing cancer, genetic effects, and long-term impacts.

The fossil energy technology program has indeed modified the processes in order to try to eliminate those chemicals from the developing technologies that they are involved in. I think it has been a very effective program. I think that when you see the distribution of these documents to the private sector, the Federal Government, and other interested individuals, you will see that the data is being delivered to the user in a timely manner.

So from my standpoint, I think we have been very successful and I think that we do have the capability to address the long-term more applied activities which are related to the technologies.

I would like to also make one important statement. We spend approximately 50 percent of our dollars in the national laboratories and 10 specialized laboratories, all but three of which are on university campuses. About 40 percent of our research dollars go to universities and related investigations.

Fifty percent go to the national labs and the rest to universities and other Federal agencies, including NOAA. Approximately $90 million of other agency funds are being spent in our laboratories to do work for those agencies.

This, I think, speaks very well to the caliber of the scientific expertise and the facilities of the Department of Energy of the past 40-some years.

Senator **Durenberger**. I didn't want to imply by the question that I didn't agree with your conclusion. I think other than some perceptual problems that we will have to deal with all of the time, it seems to me most appropriate and obviously the record of the ADC's, going way back to the beginning, was reluctant of that. But the concern always comes in terms of, I think, the word you used was capability and one of the things we are trying to do here is to determine the capacity that the Department has to address some of these needs and sometimes you measure that in terms of dollars, sometimes you reassume it in terms of the capacity of people inhouse to do this. I have only been here 5 years, but on this committee only a year, but I can recall back to 1979 when the then Secretary came up here to the Congress and about two-thirds of the time on a wide variety of things we had problems, as you well know.

Over in the Governmental Affairs Committee, Abe Ribicoff, who was then the chairman, just stopped the whole process one day and said, "I am personally so bothered by what I have been hearing in bits and pieces here and with the fact that when I call the Secretary of Energy up here to talk about it, he says, 'Well, there is something going on here,' " we just stopped the process and had a couple of days of hearings. So we brought scientists in from around the country to talk about and some of these things.

It just seems to me that because DOE has been in such a state of flux for so long, and that to a degree its mission may not be well understood by the country, to a degree there really isn't an articulated national energy policy that we can accuse the new administration of changing us from this direction to that direction, focus on solar, you should have been putting all of your time and effort in trying to save the nuclear industry and get us to burn more coal, et cetera, that there are always some concerns on the part of people that the DOE hasn't been given the right capabilities to carry on some of these appropriate efforts.

I want you to assure me that I am wrong in coming to that conclusion or that there might be some recommendations which you might make to us in terms of how to increase the capability at the DOE.

Dr. **Ostenso**. I was negligent in not making the record clear. In NOAA we do have aggregations of capability. Our strength, of course, is in meteorology and oceanography and DOE does have problems. They turn to us for expertise. We have groups of researchers who have been working solely under DOE support, going back before there was a DOE or long before there was a NOAA.

This is not a master-slave relationship. It is a true intellectual partnership of both agencies. It has been probably as healthy an example of interagency cooperation as you can find in this place.

Senator **Durenberger**. Dr. Bridgewater, if I go down the list in today's hearing, the national acid precipitation assessment program, the EPA, the Department of Health and Human Services, the USGS, the Department of Interior, the Department of Energy, NOAA, et cetera, some people who weren't here for one reason or another.

I would ask the National Science Foundation, given the questions that I raised in the beginning about particularly long-term research and development needs, what advice would you leave the subcommittee with in terms of the role that NSF can or should be playing in the National Government's commitment to research and development?

Dr. **Bridgewater**. As I said, our mission basically is to work the role of providing some assurance that there is a healthy scientific enterprise. And in order for academic scientists to be involved in some of the environmental concerns, we really have to focus on the more fundamental aspects.

We have taken an active role in terms of identifying 11 sites for long-term ecological research, ecological research that is not addressing the specific problems but identifying sites that have characteristics that are of crucial importance to the potential areas of the environmental concern.

Our scientists clearly should be available not just to you but also to the other agencies. And we hope that the knowledge that they gain through the programs that we support they will share with the mission agencies.

Certainly, the publications that they have produced are available in the agencies to utilize. They are participants in the national industry, such as the National Academy of Sciences and the studies that relate to acid rain and the environmental concerns. So we feel that there is a very strong connection between what we do and what the mission agencies do right now.

The advice for you that I have as an official in the National Science Foundation is obviously that environmental research is going to be a continuing concern to the Nation and, therefore, it does need to sustain the steady support from not just the administration but also from the Congress. We would expect that there will be a slow but steady growth in the national support of the fundamental environmental research of the type that the National Science Foundation supports.

Senator **Durenberger**. One of the reasons that this subcommittee undertook this analysis was the fact that there is an impression out there that somehow in the last couple or 3 years we have come to the conclusion that we can sort of evolve responsibility for research and development and hold some of it in our own, what I characterized earlier as the bureaucracy but we can evolve the rest of the responsibility out there to the private sector and/or do we tend to evolve it down the State level and have a certain amount of research and development down at that level of government.

Then, there are some who have said that research, when the Federal Government was fat and nobody cared about deficits, that our research programs were just good ways to keep institutions of higher learning alive and people that build up this school or that school did it off of Federal grants and people who lived off Federal grants. Now there seems to be some concern that they won't be able to do that anymore and lost in that whole effort is a concern as to how we, as a nation, approach the whole issue of scientific research.

Compared to certain other countries, I am somehow given the impression that we don't, at the present time, appear to have quite the same commitment to some research balance between the private sector, the academic sector, and the Federal Government level that you will find again in some of the more developed countries around the world.

Are you able to give us sort of a view now, on America not necessarily, but what some other countries, for example, Japan, Western Europe, and so forth, how they approach some of these issues and what the role of the National Government is vis-a-vis the other entities?

Dr. **Bridgewater**. I think I would rather talk about America.

As you may know, the National Science Foundation's program on small business research was the model program that spread to a number of the other Federal agencies.

We have each year a number of publications that are considered to be particularly important to the Nation to the type of research that the Foundation typically supports. Many of those areas are in the environmental areas. So we have essentially a solicitation of the involvement of the small businesses in research that relate to some issues of importance to the environmental concerns and to that extent we definitely are fostering the kind of links between academia and industry that you feel and I feel also are important.

I am not an expert on what other countries are doing in the matter of establishing special emphasis, but certainly many of the systems have much greater connection between the universities and there are many efforts underway; the Foundation has, also others.

Senator **Durenberger**. I guess my last question, I will go back to acid precipitation and some of the energy-related problems that we preceive in this country. I think you all know that I made a proposal on how, at the national level, we can deal with the emissions problem which will move us from a regulatory approach to what I will call the ask-to-spend approach.

One of the concerns after you get past the concerns that Dr. Bernabo is responsible for largely, which is the assessment of the impact of when you step back to the source problem one of the concers is that we just lack enough information to be able to determine how ruch the emissions problem may be from this particular source versus that particular source.

What is the current state of the art in terms of knowing how much sulfur dioxide, how much NO_x, some of these other things, are coming from one particular source as against other sources?

Is that a difficult problem if you were to move in the direction of an emissions task?

Wouldn't it be difficult to treat every emitter somewhat differently in this country because of the information?

Dr. EDINGTON. I am certainly not an expert in the control of emissions but it is my understanding that it is very difficult to determine the particular source for a particular pollutant in a specific location.

What we are trying to do in the Department of Energy in cooperation with NOAA, EPA, and with the Electric Power Research Institute, is to determine through the captex study, which is the cross-appalachian transport experiment, is to determine what the atmospheric processes are that are involved in moving pollutants from a specific site to areas which are distant by thousands of kilometers, perhaps. This is done by using a specific tracer per flurocarbon, which is released in Ohio and also at Sudbury, Canada. They hope to be able to monitor the movement of that particular tracer at select ground stations, with airplanes and balloons.

The experiment will give us some idea of the meterological problems that are involved in the transport of that material. The process involved in transformation of sulfur dioxide, let's say, to a sulfate which could be deposited as an acid is a much more difficult problem and I think that there is very little known about those processes.

I think there is information with respect to how much NO_x contributes to acid precipitation and how much SO_x contributes to the acid deposition, but I am sorry, Mr. Chairman, I just don't remember the figures.

Senator DURENBERGER. I wasn't trying to pin you down on the figures. It is just that if this thing gets out of hand, if Dr. Bernabo talks to enough people and if it spreads across the country and everybody is getting excited about the problem, something is going to happen. And what is going to happen is going to directly affect your mission at DOE.

Let's suppose the proposed approach is going to take effect; that is, we are going to take down 10 million tons, whatever it is, in the next 20 years. That is going to have a teriffic impact on the coal industry. It is going to have a teriffic impact in your area.

My question is, what, if anything, is DOE doing about that impact?

Dr. **Edington**. The DOE Office of Fossil Energy is addressing the control of pollutants from fossil energy sources in three ways: First, they are looking at warp for physical and chemical cleaning of the coal prior to combustion. In these processes, one pulverizes the coal to a size that is like a talcum powder, and sulfur is removed from the coal before it is put in the boiler. Second, they are also looking at advanced ways to improve the combustion of coal so that at lower temperatures one may reduce, not only most of the sulfur dioxide, but also the nitric oxides provided in combustion. Third, they are also developing new ways of actually removing particulates, sulfur, nitrate, or nitric oxides from the stack.

So, in those three ways, they are looking at advanced ways of actually controlling the emissions and they think that they can remove about 90 percent of the sulfur using one or the other or a combination of these approaches before anything is released in the environment.

Senator **Durenberger**. I know I don't have a secretary here to ask this question of: But you have got, as you said so clearly in your testimony, the nuclear industry here and we all know the trouble that they are in, you have got coal over here and somebody is going to make trouble for them and you have got the low sulfur, high sulfur problems.

We all know the condition the synfuels business is in. I won't belabor the problem. If we are to be concerned about the energy future of America, which now we are not too concerned because we supposedly have a surplus, but all of a sudden the French are selling airplanes to Iraq, we are all getting upset about the energy future of America.

You don't come to these conclusions overnight. What role is DOE playing right now in trying to push this whole issue of acid deposition to some kind of a conclusion, other than just the studies that you are talking about?

Is there a deep concern in DOE for the problems of acid deposition and what the politicians might do in that environment as it relates to America's energy future?

Dr. **Edington**. I think there is a deep concern, Mr. Chairman, and I think that our contribution in research in trying to resolve that problem in addition to the control technology activities in the Department at the present time are positive indications of our concern. Our participation in the acid rain task force also indicates that we are very much concerned about manmade sources, which release SO_2 or NO_x to the environment, and in addition, we are concerned about the actual processes involved in the transport, and chemcial transformation and wet and dry deposition of acidic material and their effects on the aquatic and terrestrial environments.

In addition, in the Office of Energy Research and also in the Office of the Assistant Secretary for Environmental Protection, Safety and Emergency Preparedness, we contribute a considerable amount of money to assist EPA and the task force in assessing what the actual facts are in the acid rain deposition or acid deposition problem area.

So we are contributing dollars to that activity and in addition we are trying to control, that is reduce the amount of materials that are coming out of the stacks or out of the processes themselves. I think there is a deep concern on the part of the Department of Energy in this area and for a reason which is related to what you said. Even though we have a tremendous data base on radiation effects, there is a perception that low level radiation may be worse than the risk one sees or is reflected in radiation standards. Until one can actually get a handle on the effects produced at low-level exposures which currently is very difficult if not impossible to do we will have that perception problem.

So what one has to do is support research on a long-term basis that allows us to develop the means to measure low-level effects, whether it be radiation or whether it be chemicals. That is the direction that our biological and environmental research program is pushing.

Senator DURENBERGER. As I indicated, we have questions that I will submit to you and your responses will be part of the record.

I am grateful to all three of you and the other witnesses for the time and effort that you put in on this subject. Obviously, you all care a great deal about where we are headed in the future, as the length and accuracy of your statements would indicate.

I appreciate your being here and I appreciate very much your testimony. The hearing will adjourn.

[Whereupon, at 12:23 p.m., the subcommittee recessed, to reconvene at the call of the Chair.]

STATEMENT OF
DR. COURTNEY RIORDAN
ACTING ASSISTANT ADMINISTRATOR
FOR RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
OCTOBER 17, 1983

Good morning, Mr. Chairman. I am pleased to be here to discuss the highlights of EPA's FY 1984 research plan and the associated resources. Our 1984 appropriated level is $245.0 million and 1,787 workyears. This represents an increase of $19.0 million above the resources appropriated to us in 1983, and a decrease of 75 workyears.

First, I would like to highlight several major actions we are taking to improve the scientific quality, relevance and usefulness of our research products. One of our highest priorities is to improve the quality and validity of the data we generate by implementing and monitoring a vigorous quality assurance (QA) program. An Agency-wide QA policy committee has been established to oversee QA efforts and recommend any necessary remedial measures. In addition, we are writing a manual that will carefully describe the specific roles that managers within ORD and throughout EPA must assume in implementing QA procedures. These enhancements are reflected in increased resources of $1.1 million in the Interdisciplinary, Superfund, Drinking Water, Pesticides, and Hazardous Waste media.

In another move to improve the scientific quality of our research, we have instituted a laboratory peer review program. Major portions of the research program are now being peer reviewed on a systematic basis in accord with established guidelines.

I should note that over the past few months, some proposals to reorganize the Research and Development (R&D) Program have been considered. But, Mr. Ruckelshaus has examined the entire Agency program structure and concluded that major revisions in the organization of the Research and Development Program are not required.

However, we aim to improve the timeliness and usefulness of our research products through several internal management reforms. First, we have modified our planning process to strengthen further the linkage between the research function and the client program offices in EPA. In consultation with the client offices, we have developed broad research strategy documents for each of EPA's major regulatory responsibilities (air, water, toxics and pesticides, hazardous waste), as well as for energy, including acid deposition, and for Superfund support. These strategies provide the basis for formulating our budget request.

Second, we are implementing an automated information system which clearly links our strategic research objectives to planned accomplishments and subsequently to specific research outputs. This system will provide us and our client offices with comprehensive status reports on research in progress, and our researchers will be accountable for providing needed research products on a timely basis.

Let me turn to some of the specific research areas where increased resources will be applied.

In the air medium, we are accelerating the development of comprehensive health assessment documents for potential hazardous air pollutants. Overall, we are increasing the scientific assessments program by $2.2 million to strengthen work on the development of risk assessment criteria for hazardous and other air pollutants. To strengthen our air health effects program, we are increasing it by $4.9 million. Support for the National Crop Loss Assessment Network is being increased to develop the needed data base to assess the impact of ozone on hay and forage crops, which represent the third most important group of crops in production.

In the water quality area, some $0.7 million has been added to increase support of the Agency's Office of Water in implementing controls in areas where national technology requirements alone will not achieve water quality standards. This approach requires a strong technical underpinning to match control requirements to designated, site-specific uses. Although some States have made significant progress, additional information is needed to facilitate pollution control decisions on municipal, industrial, and nonpoint sources. States will now focus on those water bodies that may require water quality protection beyond what will be achieved through technology requirements (i.e., BAT, BPT, secondary treatment). An additional $0.6 million is being added to support work to assess the impacts of ocean dumping of wastes and the discharge of municipal wastes through ocean outfalls. This research will focus on developing procedures to biologically monitor the long-term effects of ocean dumping, and will verify methods used to predict outfall impacts. In addition, our 1984 budget for water quality includes $2.5 million for work related to the Great Lakes. We will concentrate on research to understand the transport and fate of toxic pollutants in the Great Lakes.

Another area of increase is acid rain, augmented by $2.4 million to a total of $15.4 million for FY 1984, to reflect our continued concern in understanding the causes, atmospheric processes and effects of this phenomenon. Total government acid rain funding will be at $27.6 million in 1984, compared to $23.3 million in 1983.

Health research is funded at $49.5 million in 1984, an increase over the 1983 level of $40.1 million to ensure that we continue to develop the information necessary to protect the health of the American people. This includes an increase of $2.8 million in toxics health effects research, most of which is for improving techniques for extrapolating research effects from animals to humans, providing epidemiology support, and developing predictive techniques.

The FY 1984 appropriation allows continued support of other critical programs at approximately the same level as in 1983. Groundwater research will continue to contribute to the scientific and technical information base to help us respond to groundwater pollution problems through the various environmental statutes. Increases in 1984 will fund studies on Temik contamination of drinking water supplies in Florida, and work on correlating geological structures with groundwater contamination.

Our Superfund support program increases by $2.3 million and emphasizes quality assurance activities supporting site assessments and field evaluation of control technologies, and provision of technical assistance for enforcement actions.

In our exploratory research program, which is continuing at the same level of funding in 1984, we are instituting management changes in the exploratory research centers program to focus more effectively on long-term Agency needs. The 1984 budget will continue to support the centers at eight academic institutions throughout the country. Each center specializes in a particular area of research and seeks solutions to environmental research problems through long-term studies. In 1984, the themes of these centers will be reviewed, and they will be managed to assure that their work is more focused on Agency needs and more clearly defined. In the competitive research grants program, we will also continue to explore research problems that require long-term, innovative work to achieve solutions. We will, however, institute changes to increase the connection between the grants program and the other Agency programs.

I will now turn to some of the major reductions that appear in our budget. These reflect the completion of work in several programs and the reorientation of the program away from areas that are not as directly relevant to EPA's legislative priorities.

The largest reduction is $4.9 million in the environmental engineering program. Control technology budget reductions reflect a shift in program emphasis toward evaluations of controls developed by the private sector, laboratory research associated with developing a fundamental understanding of the mechanisms associated with the formation, transformation, and/or destruction of pollutants, a continuation of emission evaluations from a wide variety of sources to assess the need for additional controls, and a strengthened technical assistance program that responds to the needs of Regions, States, and local governments. Capital-intensive demonstrations and control technology development have been reduced in those areas which are best addressed by the private sector. A notable exception, however, is the continued development of the Limestone Injection Multistage Burner (LIMB), which supports the acid rain research program and which, through preliminary tests, is proving to be cost-effective control technology. An additional $5.0 million was appropriated to accelerate LIMB research.

Also, it should be noted that research to support promulgation of the Effluent Guidelines has been largely completed.

Now I would like to describe the significant changes in the R&D budget in each of the media. I must add a point of clarification: All media totals have been adjusted so that the transfer of exploratory research funds into the interdisciplinary medium do not distort the year-to-year changes in research activity.

Air Research: We plan to spend $62.8 million, an increase of $8.2 million from the FY 1983 level. The air research program will continue to provide support for reviewing and possibly revising the national ambient air quality standards, and promulgating New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants. We will also continue to provide support to the Regions in their permitting, enforcement and compliance activities. In 1984, research on monitoring systems and environmental processes and effects remains relatively constant. However, we are placing additional emphasis on improving the scientific quality of the health effects data base. To improve our ability to generate dose-response data, we are initiating epidemiology studies on health problems related to exposure to sulfur dioxide, particulates and photochemical oxidants;

conducting additional animal and human clinical research; and expanding our support for the Health Effects Institute. We are also placing added emphasis on the development of criteria documents to support the possible modifications of the ambient air quality standards, and the development of comprehensive health assessment documents to support national emission standards for hazardous air pollutants.

Water Quality Research: We plan to spend $24.8 million in FY 1984, a reduction of $2.2 million from the 1983 level. There are two areas of emphasis in the water research program. In addition to the program mentioned earlier, we will continue to evaluate the technical feasibility and cost-effectiveness of innovative/alternative municipal wastewater treatment processes as well as continuing to work on sludge management options and related health impacts. The reduction in water research reflects the reduction of technology development support by EPA as noted earlier, the phase-down of the effluent guidelines effort, completion of most research in support of the water quality criteria, and consolidation of water-related health research into the drinking water research program.

Drinking Water: The budget for drinking water research is $23.8 million in 1984, an increase of $3.8 million. We will be increasing research work in risk assessment, health, monitoring and groundwater. A major expansion in risk assessment support is designed to assist the Office of Drinking

Water in the development of revised National Primary Drinking Water regulations. In the health area, we will carry out a study to assess the feasibility of conducting drinking water epidemiology research and will expand research on the health effects of disinfectant by-products and on improving validation methods to extrapolate data for health risk assessments. Monitoring and some groundwater increases will be directed at identifying any problems in Florida drinking water supplies as a result of Temik contamination. Other increases in ground-water research will support a study of the correlation between geological structures and groundwater contamination.

The base program in monitoring will continue to develop and standardize analytical methods for use by the Agency, States and the water supply industry. We will also increase the frequency of EPA Regional laboratory audits from once every three years to once a year. Since these laboratories are responsibile for auditing State labs, we believe the increase will insure more reliable drinking water monitoring. The health effects program will continue to focus on identifying the health effects of specific chemicals designated by the Agency for regulatory decisions, development of methods to identify and characterize infectious agents in water and research on the health effects of complex mixtures in drinking water.

In addition to providing technology evaluation support to the development of drinking water regulations, our drinking water engineering program will carry out research to improve the effectiveness and lower the cost of drinking water treatment. This program will be especially oriented to the problems of small systems. Engineering research will also provide for matching water supply industry research efforts geared toward solving operational problems.

Ground-water research will continue to improve methods for determining the fate and transport of contaminants in the subsurface and to evaluate the cost-effectiveness of aquifer reclamation methods.

Hazardous Waste: We plan to spend $32.3 million in FY 1984, an increase of $1.6 million from the 1983 level. Research activities in this medium will provide the scientific data needed to support the cost-effective implementation of land disposal and incineration regulations. We will continue to develop procedures to support listing/delisting decisions, and we will validate newly developed methods for identifying hazardous wastes. Through field testing, we will improve our ability to predict the behavior of hazardous wastes in the environment by determining the chemical-specific factors that control such behavior.

Pesticides: We plan to spend $6.3 million in FY 1984, an increase of $ 0.4 million from the 1983 level. This small increase reflects the augmentation of health test methods development for non-carcinogenic effects. Our research program will develop methodologies to determine more accurately the risks associated with pesticide exposures by integrating effects and exposure data. In particular, we will improve methods to assess the exposure of specific populations to pesticides so that the risks to these groups can be determined more accurately.

Since the charters of the agencies concerned with pesticide registration and re-registration are significantly different, we maintain informal contact with Health and Human Services, Agriculture and Interior at all managerial levels. At the laboratory level, we have continuing interagency contacts, and, where appropriate, interagency agreements are established to allow us to draw on the technical resources and skills of other agencies. Examples of such interagency agreements include work with the U.S. Geological Survey and the USDA Soil Conservation Service on our Dougherty Plains, Georgia program to study pesticides movement through the soil; the Department of Interior Fish and Wildlife Service support for our Corvallis Lab on pesticide feeding studies using quail; and cooperation between our Gulf Breeze Lab and Eglin Air Force Base on a field study involving pesticides spraying. We have also completed a study for the National Cancer Institute using fish as a model for the carcinogenic potential of polluted marine waters. We participate with the Office of Pesticide Programs in its interagency agreement with the Department of Labor to study whether the young differ from the mature in their toxic response after exposure to pesticides.

Radiation: We expect to spend $1.8 million in FY 1984, an increase of $0.3 million from the 1983 level. The radiation research program will concentrate on providing quality assurance to support Federal, State and local radiation laboratories. The health component of this program, focusing on the effects of non-ionizing radiation, will concentrate on modification and extension of the radio-frequency guidance, which is scheduled to be issued in late 1984.

Additionally, we will continue our monitoring program at the Nevada Nuclear Test Site. We perform these surveillance services under a reimbursable arrangement with the Department of Energy.

Interdisciplinary: The funding level for 1984 is $20.8 million, an apparent increase of $13.4 million over the 1983 level. Through the Interdisciplinary program, EPA manages the exploratory research program which includes competitive research grants, the exploratory research centers, and the dissemination of technical information products to the various user communities. ORD regularly distributes a listing of summaries of the reports resulting from our completed research projects. These summaries are available to interested scientists and engineers, and all our publications are available from the National Technical Information Service.

We also publish extensively in scientific journals. ORD prints and distributes specialized technology transfer materials in direct support of the Agency's regulatory and enforcement activities. The increase of $13.4 million results from the transfer and consolidation into this medium of exploratory research funds from other media, as well as an accelerated, agency-wide, QA management program, and a consolidated uniform risk assessment effort.

Toxic Substances: We plan to spend $24.5 million in FY 1984, an increase of $1.1 million from the 1983 level. The 1984 research program will concentrate on determining which chemical substances pose unreasonable risks to man and the environment. Test methods to measure these risks will be developed and validated using data from field studies. These risk methods development activities will provide an improved means for supporting TSCA risk assessments and the premanufacture notification process. We will continue to improve our ability to predict the fate and toxicity of chemicals in the environment using structure-activity relationships. The increase will expand our program on extrapolation of research data from animals to man and high to low doses as well as provide support for epidemiology studies.

The Interagency Testing Committee, established under section 4(e) of TSCA, is managed by OTS with consultation from ORD. The main thrust of that Committee is regulation forcing, and the responsibility is appropriately in the regulatory office. Regarding our work with other agencies in the toxic area, our health research staff works closely with the National Institute of Environmental Health Sciences, and as an example, is very active in the Heart Lung Task Force. Our environmental processes research scientists work closely with both the Fish and Wildlife Service and the National Oceanic and Atmospheric Administration.

Energy: In this medium, we plan to spend $30.5 million in FY 1984, a net increase of $6.0 million over 1983. The 1984 energy research program continues to emphasize the development of our understanding of the causes and effects of acid rain. As noted earlier, we are increasing the acid deposition program by $2.4 million. Another major component of the energy program is the expansion of development efforts for the Limestone Injection Multistage Burner control technology by $5.0 million. This technology simultaneously controls NO_x and SO_2 and offers potential benefits in terms of reduced capital and operating costs for coal burning boilers. Engineering technical assistance to Regions and States has been reduced by $1.6 million due to the stretch out of the timetable for synfuels commercialization.

Our energy program is closely associated with that of the Department of Energy, through the use of several mechanisms.

In several areas, such as risk assessment of pollutants associated with the synfuels industry and control technology for fossil energy systems, we and DOE hold workshop sessions to compare research program plans and develop cooperative efforts. These workshops are a means of sharing information on each agency's program plans, identifying new areas for cooperation on specific subjects, and establishing the necessary plans to carry these out. Resulting from these workshops are joint programs with DOE, through which we share costs and divide responsibility for various parts of the program. For example, in the synfuel risk analysis area, DOE's Brookhaven National Laboratory serves as the principal investigator to develop our health data. The Oak Ridge National Laboratory develops the majority of our synfuel environmental data.

We also cooperate with DOE through participation in Interagency Task Forces, for example, those for acid precipitation and for geothermal energy systems. Unlike the workshops and programs described above, which bring together the two agencies, these task forces involve many Federal entities. For example, the Interagency Task Force on Acid Precipitation involves nine agencies.

Coordination with the DOE also occurs in the form of consultation to the Synthetic Fuels Corporation (SFC) monitoring plans. Section 131(e) of the Energy Security Act requires EPA and DOE consultation with U.S. Synthetic Fuels Corporation applicants on preparation of environmental monitoring outlines/plans for its synfuel plant operation. This consultation has resulted in joint EPA/DOE collaboration with the SFC on preparation of their Environmental Monitoring Guidelines and review of 10 SFC applicant monitoring outlines/plans.

Superfund: We plan to spend $8.8 million in 1984, an increase of $2.3 million from 1983 levels. The increase will provide additional quality assurance which supports site and situation specific assessments and Superfund enforcement activities. Technical support activities will also continue in evaluating technologies to be used for removal and remedial operations. Further, the research program will support on-scene coordinators by producing a handbook which they may use to make decisions regarding the necessary extent and duration of emergency and remedial response actions.

I hope my statement has provided you with a satisfactory overview of our research program. I believe our 1984 program provides for a responsive, balanced, and high quality environmental research program. It is the product of much review and scrutiny by our many clients: the EPA regulatory and enforcement programs, Regional Offices, and the scientific and regulated communities, and reflects specific Congressional guidance.

Thank you, Mr. Chairman. This concludes my presentation.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 8 [illegible]

OFFICE OF
THE ADMINISTRATOR

Honorable Max Baucus
Ranking Minority Member
Subcommittee on Toxic Substances
and Environmental Oversight
Committee on Environment
and Public Works
United States Senate
Washington, D.C. 20510

Dear Senator Baucus:

This is in response to your request of November 7, 1983, for answers to a series of questions submitted by your subcommittee concerning Federal environmental research and development.

We appreciate the opportunity to augment the hearing record for Federal environmental research and development and apologize for our delay in responding. If I can be of further assistance, please contact me.

Sincerely yours.

Gregg Ward

Gregg Ward, Director
Office of Congressional Liaison

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Senator Durenberger:

1. QUESTION:

In the past, there has been a significant gap in EPA's regulatory efforts in terms of standard-setting. Has a weak linkage between client program offices and the research functions been an impediment to timely standards issuance? How will you strengthen the linkage?

ANSWER:

The linkage between the Program Offices and the Office of Research and Development (ORD) has been very strong regarding the cooperative planning and prioritization of research to support the regulatory process scientific needs. Research Committees, co-chaired by ORD and program office managers have served as an effective communication channel. Improvement of the quality of science within ORD has been a major goal and to achieve that goal we have implemented a very strong scientific peer review process.

The Agency is in the process of initiating procedures which will ensure involvement of ORD and other "key" Assistant Administrators early in the regulatory development process as well as in the evaluation of regulatory options. ORD will assign key managers and/or scientists to work on development of regulations, principally responsible for the assurance that scientific issues are fully addressed during that process.

As the scientific arm of the Agency, ORD has a major stake in the credibility of all scientific work undertaken by EPA. ORD provides consultative assistance to other Assistant Administrators and review of publications. We would like to see these roles be expanded and are currently developing several options for the Administrator to review which could bring this about.

Senator Durenberger :

2. QUESTION: You have mentioned an increase of $0.7 million in the Office of Research and Development's budget to provide support in areas where national technology requirements will not meet water quality standards. What type of information will be generated by this research effort?

RESPONSE: A major objective of EPA's water quality research program in FY 1984 is to provide the information and tools needed by Federal and State permit programs to correct ambient water quality problems that remain after the mandated minimum pollution control technology (e.g., secondary treatment, effluent guidelines) is in place. The $0.7 million increase in R&D funds will focus on three key areas: (1) Use attainability assessments. The "post-technology approach" to water pollution control focuses on protecting uses of water (i.e., recreation, fish and wildlife, public water supplies, agricultural and industrial uses, navigation). Use attainability research will provide techiques for States to use in assessing current ecological conditions of a water body, the biological potential and the non-water quality features (e.g., water flow, temperature and depth; habitat; adjoining land use) necessary to achieve desired uses. (2) Site-specific water quality criteria. When states set water quality criteria for a particular water body, there can be a need to account for local environmental factors that alter the ability of the water body to assimilate pollutants and to consider variations in the sensitivity of resident species to pollution. The modest funding increase will accelerate research already underway to field test methods that modify national criteria to account for site-specific variations. (3) Complex effluents toxicity testing. A chemical-by-chemical approach to limiting pollutant discharges to aquatic ecosystems is cumbersome and expensive when a large number of pollutants are present. This research will develop protocols for complex effluent toxicity testing that can be used to establish permit limits for complex mixtures of wastes based on the net toxicity.

QUESTIONS FOR DR. RIORDAN -- EPA
Submitted by Senator Durenberger

Question 3.

An increase in the 1984 R&D budget pertaining to groundwater is intended for study of Temik contamination of drinking water supplies. Extensive research has been undertaken by state and private organizations in areas affected by Temik contamination. What are the objectives of these new studies?

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EPA in cooperation with the University of Florida has initiated a research program to study the potential threat of TEMIK (aldicarb) from contamination of groundwaters in and near Florida citrus groves. This effort is in cooperation with the State of Florida Department of Agriculture, Department of Environmental Regulations, Florida Health and Rehabilitative Services, and the US Geological Survey. In addition, it is expected that either samples or analytical data will be available to the cooperative program from sampling done by the Union Carbide Corp. from 200 private wells in the same counties.

Monitoring data obtained from the State Agency and University of Florida analysis will be combined with previously obtained data and ongoing monitoring efforts by the various State Agencies in a form suitable for evaluation by others in various models of the fate and transport of chemicals in the environment. This evaluation is expected to provide a basis for testing models of movement of agricultural chemicals in the environment. Guidelines will be developed to assist State and Federal Agencies in the development of programs related to the safe and satisfactory use of agricultural chemicals while protecting the quality of the country's groundwater.

The cooperative agreement with the University will allow the state to obtain a great amount of monitoring data they would not otherwise obtain and will reduce the cost to EPA by at least 50%.

There are many others who are interested in this work, such as Florida Citrus Mutual, Agricultural cooperatives, environmental groups and the like. They intend to cooperate but are not expected to participate directly.

Senator Du berge.

QUESTION #4

Ambient monitoring of air and water quality are carried out throughout the nation by Federal, State, and local entities. Only a small percentage of this measurement data is ever organized into useful national and regional scale data bases. Does EPA have any initiatives planned in this area?

ANSWER

The Agency has two specific Agency-wide initiatives underway that bring together measurement data on both the national scale and regional scale--Regional Environmental Management Reports and a National Environmental Management Report. A third Agency-wide initiative--a Monitoring Task Force--addresses how to improve environmental monitoring and establish procedures that ensure data can and are organized into useful national and regional scale data bases.

Environmental Management Reports

The Environmental Management Reports (EMRs) were begun in 1982. Each of the 10 EPA Regional offices is responsible for preparing these reports which describe:

- the general status of and trends in environmental quality in the Region;
- the most significant remaining and emerging environmental problems (including both abatement and prevention problems);
- the causes associated with these problems;
- the barriers that exist to solving the problems; and
- what actions have been taken or are planned.

One section of the EMR provides detailed analysis of the most significant environmental problems, many of which are located in limited geographical areas.

The EMRs deal with all media and cover all of EPA's environmental programs. EPA is currently evaluating the process and the best schedule for producing such reports.

National Environmental Management Report

EPA is in the process of using the EMRs, along with other environmental data, to prepare a national report. This report summarizes national and regional environmental data to give baselines and trends information. The major environmental problems facing the nation and EPA's planned actions to address these problems will be identified and discussed. This report is presently in draft and is being reviewed within EPA. The final report is scheduled to be available for distribution in March, 1984.

Monitoring Task Force

The Deputy Administrator established a Task Force on Environmental Monitoring in August, 1983. The Task Force was charged with developing an Agency-wide monitoring policy, preparing guidance for programs to develop program monitoring strategies, and clearly defining the roles, relationships, and responsibilities associated with monitoring within Headquarters, among Headquarters and the Regions, and between EPA and State and local agencies.

The Task Force has completed development of the policy, and it is being reviewed by the senior managers prior to being issued. Several parts of the policy deal with ensuring that data collected by one group will be adequately quality assured, documented, and accessible to others who would find the data beneficial. In addition, two specific aspects of the policy will promote the use of data on national and regional scales. These are:

- Agency managers should report regularly to the Administrator environmental information and the policy implications for their programs.
- Agency managers should routinely develop reports which interpret and make available to the public significant data and findings of monitoring programs, including those describing important national trends or emerging problems and the strategies in place or planned for addressing those problems.

Program-Specific Efforts

In addition to these Agency-wide initiatives, individual programs have efforts underway. For example, the Office of Water is using State reporting, particularly the Section 305(b) reports, and the reports developed this past summer under the joint leadership of EPA and the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) entitled "States' Progress Under the Clean Water Program " (STEP). The STEP project was initiated to develop a system to better assess the progress that has been made in water quality through water programs over the past decade. The draft guidance for the 1984 State Section 305(b) Reports incorporates many of the indicators developed through the STEP project to establish a system by which progress in water quality can be tracked in the future. This guidance also requests information on the progress of the States towards the fishable/swimmable goal set in Section 305(b), information on the effects of toxics on human health and aquatic life, and other remaining water quality problems.

The Office of Air and Radiation annually publishes the report National Air Quality and Emission Trends Report which brings together a large amount of State, local and EPA data to quantify air quality trends. The report is directed toward both the technical air pollution audience and the interested general public.

Senator Durenberger:

5. Question:

How soon so you expect the Office of Drinking Water will be able to produce primary drinking water standards with the slight increase in research budget? Are any cooperative efforts planned to expedite this process?

Answer:

The increase in the research budget for FY 84 has limited bearing on the timetable already laid out for accomplishing the revision of National Primary Drinking Water Regulation, except in a few areas where direct assistance is being provided from the Office of Research and Development (ORD) and for the documentation effort. The Office of Drinking Water (ODW) has been engaged for several years in the first stages of the revision process, with proposal of new recommended maximum contaminant levels (RCMLs) for volatile organic chemicals projected for February 1984, and similar proposals for many other inorganic, microbiological and synthetic organic chemicals for late 1984. New research starts generally show results 2 to 4 years hence.

ODW has enlisted the help of ORD's Office of Health and Environmental Assessment (OHEA) in a cooperative effort developing a number of the health criteria documents associated with RMCLs for the current proposals. Seven additional full time equivalent positions have been provided for this activity.

The increase in research related to drinking water for FY 84 is $2.0 million above the FY 83 level. This will augment current research, much of which relates to the later phases of standards revision. This includes gathering additional data relating to analytical methods and treatment processes for chemicals being considered for regulations and the revision of standards for radionuclides and controlling organic chemical by-products of chlorination. These are scheduled for 1985 and beyond.

One million dollars of the FY 84 budget is slated for a new cooperative agreement with the American Water Works Association Research Foundation for joint projects in monitoring and treatment technologies. This will be useful in increasing compliance with new and exisitng standards but it has little bearing on the timetable for development of new standards.

Senator Baucus

1. Question: During the budget hearing earlier this year, I inquired as to what EPA was doing in researching the health effects from wood smoke generated in fireplaces and wood burning stoves. You indicated that there was a modest effort to characterize emissions from wood burning stoves.

Is this effort still being supported and what is the status of the program?

Answer: At present, we are reevaluating the future of our research effort on the health effects of wood smoke from residential sources. In two programs -- the air cancer project and the air toxics area (related to hazardous air pollutants) -- we are considering the priority of wood smoke. Future program plans should emerge during this calendar year.

There is one ongoing research task: samples of particulate pollutants of residential wood combustion captured in previous studies are undergoing chemical fractionation and will be subjected to bioassay tests. These tests will provide an indication of the mutagenicity of the different fractions, and in so doing help identify their carcinogenic potential.

QUESTIONS FOR DR. RIORDAN--EPA
Submitted by Senator Baucus

2. You include some details of the increases to the R&D budget above the President's FY 84 request. Would it be possible to provide the entire R&D operating plan to the Subcommittee?

The attached chart presents the FY 84 R&D operating plan by decision unit.

You indicate that the FY 84 R&D appropriations level is about $30 million higher than the initial request, but includes a decrease of 75 workyears compared to FY 83. Where will the decreases in personnel occur?

The same chart compares the FY 84 operating plan to that of FY 83 and thereby shows the areas where the FTE decreases occur.

Attachment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
BUDGET ANALYSIS RESOURCE SYSTEM

FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
BY DUMEDIA, DUCODE, APPROP

A AIR QUALITY

(HARS 01)

EXCLUDES REIMBURSEMENT DOLLARS S&E AND R&D APPROPRIATIONS ONLY [illegible] [illegible] RESOURCE 07	(1) FY 1983 FINAL OPLAN TOTFTE	(2) TOTAL$$	(3)	(4) FY 1984 12/1 OPLAN TOTFTE	(5) TOTAL$$	(6)	(7) 4-1=7	(8) 5-2=8	(9)
A SALARIES & EXPENSES	101.2	4,995.7		107.1	5,841.1		5.9	845.4	
C RESEARCH & DEVELOPMENT		8,289.1			8,849.4			560.3	
A103 OXIDANTS	101.2	13,284.8		107.1	14,690.5		5.9	1,405.7	
A SALARIES & EXPENSES	99.7	4,574.4		108.0	5,855.0		8.3	1,280.6	
C RESEARCH & DEVELOPMENT		3,596.3			6,871.3			3,275.0	
A109 HAZARDOUS POLLUTANTS	99.7	8,170.7		108.0	12,726.3		8.3	4,555.6	
A SALARIES & EXPENSES	33.0	1,864.4		28.6	1,654.4		-4.4	-210.0	
C RESEARCH & DEVELOPMENT		4,330.5			4,424.0			93.5	
A114 MOBILE SOURCES	33.0	6,194.9		28.6	6,078.4		-4.4	-116.5	
A SALARIES & EXPENSES	233.5	12,244.6		207.4	11,660.0		-26.1	-584.6	
C RESEARCH & DEVELOPMENT		18,122.9			17,224.4			-898.5	
A119 GASES AND PARTICLES	233.5	30,367.5		207.4	28,884.4		-26.1	-1,483.1	
A AIR QUALITY	467.4	58,017.9		451.1	62,379.6		-16.3	4,361.7	

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                                   UNITED STATES ENVIRONMENTAL PROTECTION AGENCY                                    PAGE      2
                                          BUDGET ANALYSIS RESOURCE SYSTEM                                           12-02-83
                                                                                                                    DAYE=4
                              FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN                        TIME 15:43:[illegible]
B WATER QUALITY                              BY DUMEDIA, DUCODE, APPROP

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                                                                                                        (MARS 01)
EXCLUDE REIMBURSEMENT DOLLARS      ( 1 )      ( 2 )      ( 3 )      ( 4 )      ( 5 )      ( 6 )      ( 7 )      ( 8 )      ( 9 )
REGULAR APPROPRIATIONS ONLY            FY 1983                             FY 1984
HQA ONLY                              FINAL OPLAN                         12/1 OPLAN
GROUP GRANT PES-RPIO 97
                                   TOTFTE     TOTALS$               TOTFTE     TOTALS$               4-1=7      5-2=8
------------------------------------------------------------------------------------------------------------------------------

  A SALARIES & EXPENSES             256.7   11,000.9                 243.0   10,071.0                -13.7     -929.9
  C RESEARCH & DEVELOPMENT                   3,591.7                          4,976.5                          1,384.8

 B107 WATER QUALITY                 256.7   14,592.6                 243.0   15,047.5                -13.7      454.9

  A SALARIES & EXPENSES             101.2    4,988.3                  58.3    2,772.0                -42.9   -2,216.3
  C RESEARCH & DEVELOPMENT                   5,830.5                          5,077.1                           -753.4

 B113 MUNICIPAL WASTEWATER          101.2   10,818.8                  58.3    7,849.1                -42.9   -2,969.7

  A SALARIES & EXPENSES              58.3    3,221.3                  25.5    1,406.7                -32.8   -1,814.6
  C RESEARCH & DEVELOPMENT                   1,851.6                            416.9                          -1,434.7

 B116 INDUSTRIAL WASTEWATER          58.3    5,072.9                  25.5    1,823.6                -32.8   -3,249.3

B WATER QUALITY                     416.2   30,484.3                 326.8   24,720.2                -89.4   -5,764.1
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                              UNITED STATES ENVIRONMENTAL PROTECTION AGENCY                                  PAGE     3
                                 BUDGET ANALYSIS RESOURCE SYSTEM                                             12-02-83
                                                                                                            DATE-4
                         FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN                       TIME 15:43:49
                                       BY DUMEDIA, DUCODE, APPROP
C DRINKING WATER

                                                                                                  (MARS 01)
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EXCLUDE REIMBURSEMENT DOLLARS    ( 1 )      ( 2 )      ( 3 )      ( 4 )      ( 5 )      ( 6 )      ( 7 )      ( 8 )      ( 9 )
REGULAR APPROPRIATIONS ONLY         FY 1983                          FY 1984
HQA ONLY                           FINAL OPLAN                      12/1 OPLAN
GROUP GRANT PES-RPIO 97
                                 TOTFTE     TOTAL$$               TOTFTE     TOTAL$$               4-1=7      5-2=8
----------------------------------------------------------------------------------------------------------------------

  A SALARIES & EXPENSES          170.1      7,827.3               186.4      9,390.6               16.3    1,563.3
  C RESEARCH & DEVELOPMENT                 13,789.4                          14,408.0                          618.6

 C1C4 DRINKING WATER             170.1     21,616.7               186.4     23,798.6               16.3    2,181.9

C DRINKING WATER                 170.1     21,616.7               186.4     23,798.6               16.3    2,181.9
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
BUDGET ANALYSIS RESOURCE SYSTEM

FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
BY DUMEDIA, DUCODE, APPRUP

D HAZARDOUS WASTES

(DARS 01)

EXCLUDE REIMBURSEMENT DOLLARS REGULAR APPROPRIATIONS ONLY NOA ONLY GROUP GRANT PES-RPIO 97	(1) FY 1983 FINAL OPLAN TOTFTE	(2) TOTALS$	(3)	(4) FY 1984 12/1 OPLAN TOTFTE	(5) TOTALS$	(6)	(7) 4-1=7	(8) 5-2=8	(9)
A SALARIES & EXPENSES	217.1	12,225.1		206.6	10,712.6		-10.5	-1,512.5	
C RESEARCH & DEVELOPMENT		22,457.6			21,589.2			-868.4	
D109 HAZARDOUS WASTE	217.1	34,682.7		206.6	32,301.8		-10.5	-2,380.9	
D HAZARDOUS WASTES	217.1	34,682.7		206.6	32,301.8		-10.5	-2,380.9	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
BUDGET ANALYSIS RESOURCE SYSTEM

FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
BY OUMEDIA, OUCODE, APPROP

F PESTICIDES

(MANS 01)

EXCLUDE REIMBURSEMENT DOLLARS REGULAR APPROPRIATIONS ONLY NOA ONLY GROUP GRANT FES-RPTO 97	(1) FY 1983 FINAL OPLAN TOTFTE	(2) TOTALS$	(3)	(4) FY 1984 12/1 OPLAN TOTFTE	(5) TOTALS$	(6)	(7) 4-1=7	(8) 5-2=8	(9)
A SALARIES & EXPENSES	107.1	4,114.8		108.3	4,622.0		1.2	507.2	
C RESEARCH & DEVELOPMENT		2,065.7			1,673.0			-392.7	
F104 PESTICIDES - R&D	107.1	6,180.5		108.3	6,295.0		1.2	114.5	
F PESTICIDES	107.1	6,180.5		108.3	6,295.0		1.2	114.5	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
BUDGET ANALYSIS RESOURCE SYSTEM

FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
BY DUMEDIA, DUCODE, APPHUP

PAGE 8
12-02-83
DAVE-1
TIME 15:43:48

F RADIATION

(MARS 01)

EXCLUDE REIMBURSEMENT DOLLARS REGULAR APPROPRIATIONS ONLY NOA ONLY GROUP GRANT PES-RPIO 97	(1) FY 1983 FINAL OPLAN TOTFTE	(2) TOTAL$$	(3)	(4) FY 1984 12/1 OPLAN TOTFTE	(5) TOTAL$$	(6)	(7) 4-1=7	(8) 5-2=8	(9)
A SALARIES & EXPENSES	25.4	1,102.4		22.0	777.0		-3.4	-325.4	
C RESEARCH & DEVELOPMENT		387.6			1,016.7			629.1	
F100 NONIONIZING RADIATION	25.4	1,490.0		22.0	1,793.7		-3.4	303.7	
X REIMBURSEMENTS				61.0			61.0		
F999				61.0			61.0		
F RADIATION	25.4	1,490.0		83.0	1,793.7		57.6	303.7	

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                                  UNITED STATES ENVIRONMENTAL PROTECTION AGENCY                                   PAGE      7
                                      BUDGET ANALYSIS RESOURCE SYSTEM                                                12-02-83
                                                                                                                     DAVE-4
                              FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN                         TIME 15:45:48
H INTERDISCIPLINARY                  .    BY DUMEDIA, DUCODE, APPROP

                                                                                                          (HARS 01)
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EXCLUDE REIMBURSEMENT DOLLARS     ( 1 )      ( 2 )      ( 3 )      ( 4 )      ( 5 )      ( 6 )      ( 7 )      ( 8 )      ( 9 )
REGULAR APPROPRIATIONS ONLY          FY 1983                          FY 1984
HQ& ONLY                           FINAL UPLAN                       12/1 UPLAN
GROUP GRANT PES-RPIO 97
                                  TOTFTE     TOTALS$               TOTFTE     TOTALS$                4-1=7      5-2=8
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  A SALARIES & EXPENSES            53.9     3,488.6               64.2      3,328.9                10.3      -159.7
  C RESEARCH & DEVELOPMENT                  3,423.0                        17,542.8                          14,119.8

 H100 INTERMEDIA - R&D             53.9     6,911.6               64.2     20,871.7                10.3     13,960.1

  W ABATE CONTROL & COMPLIANCE                459.7                           415.0                            -44.7

 H200 INTERDISCIPLINARY TRAINI                459.7                           415.0                            -44.7

  X REIMBURSEMENTS                 61.0                                                            -61.0

 H900                              61.0                                                            -61.0

H INTERDISCIPLINARY               114.9     7,371.3               64.2     21,286.7               -50.7     13,915.4
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                                   UNITED STATES ENVIRONMENTAL PROTECTION AGENCY                          PAGE      8
                                        BUDGET ANALYSIS RESOURCE SYSTEM                                     12-02-83
                                                                                                         DATE-4
                            FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN                 TIME 15:45:48
L TOXIC SUBSTANCES                           BY DUMEDIA, DUCODE, APPROP

                                                                                                    (HARS 01)
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EXCLUDE REIMBURSEMENT DOLLARS          ( 1 )      ( 2 )      ( 3 )      ( 4 )      ( 5 )      ( 6 )      ( 7 )     ( 8 )      ( 9 )
REGULAR APPROPRIATIONS ONLY               FY 1983                           FY 1984
NOA ONLY                                FINAL UPLAN                        12/1 UPLAN
GROUP GRANT PES-RPIO 97
                                       TOTFTE     TOTAL$$               TOTFTE     TOTAL$$               4-1=7      5-2=8
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  A SALARIES & EXPENSES                 188.7    12,667.3                190.9    12,220.6               2.2       -446.7
  C RESEARCH & DEVELOPMENT                       12,840.9                         12,275.4                         -565.5

 L19A CHEM TEST & ASSESS - TOX          188.7    25,508.2                190.9    24,496.0               2.2     -1,012.2

L TOXIC SUBSTANCES                      188.7    25,508.2                190.9    24,496.0               2.2     -1,012.2
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
BUDGET ANALYSIS RESOURCE SYSTEM

FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
BY DUMEDIA, DUCODE, APPROP

W ENERGY

(NARS 01)

EXCLUDE REIMBURSEMENT DOLLARS REGULAR APPROPRIATIONS ONLY NOA ONLY GROUP GRANT PES-RPTO 97	(1) FY 1983 FINAL OPLAN TOTFTE	(2) TOTALS$	(3)	(4) FY 1984 12/1 OPLAN TOTFTE	(5) TOTALS$	(6)	(7) 4-1=7	(8) 5-2=8	(9)
A SALARIES & EXPENSES	66.2	4,786.7		65.9	3,975.5		-.3	-811.2	
C RESEARCH & DEVELOPMENT		20,423.2			26,355.3			5,932.1	
B100 MULTI-MEDIA ENERGY PROGR	66.2	25,209.9		65.9	30,330.8		-.3	5,120.9	
W ENERGY	66.2	25,209.9		65.9	30,330.8		-.3	5,120.9	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
BUDGET ANALYSIS RESOURCE SYSTEM

FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
BY DOMEDIA, DOCODE, APPROP

PAGE 19
12-02-83
DAVE-4
TIME 15:43:48

R AGENCY MANAGEMENT & SUPPORT

EXCLUDE REIMBURSEMENT DOLLARS REGULAR APPROPRIATIONS ONLY NOA ONLY GROUP GRANT PES-RPTO 97	(1) FY 1983 FINAL OPLAN TOTFTE	(2) FY 1983 FINAL OPLAN TOTAL$$	(3)	(4) FY 1984 12/1 OPLAN TOTFTE	(5) FY 1984 12/1 OPLAN TOTAL$$	(6)	(DAMS 01) (7) 4-1=7	(8) 5-2=8	(9)
E SALARIES & EXPENSES	65.0	3,939.9		61.7	3,849.3		-3.3	-90.6	
R167 PROGRAM MGMT-ORD	65.0	3,939.9		61.7	3,849.3		-3.3	-90.6	
B SALARIES & EXPENSES		5,111.4			4,710.4			-401.0	
R550 SUPPORT SERV-ORD		5,111.4			4,710.4			-401.0	
R AGENCY MANAGEMENT & SUPPORT	65.0	9,051.3		61.7	8,559.7		-3.3	-491.6	

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                                                                                                         PAGE    11
                              UNITED STATES ENVIRONMENTAL PROTECTION AGENCY                                12-02-83
                                 BUDGET ANALYSIS RESOURCE SYSTEM                                         DAVE=N
                                                                                                     TIME 15:13:48
                         FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN
Y SUPERFUND                           BY DUMEDIA, DUCUDF, APPRUP

                                                                                                      (HARS 01)
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EXCLUDE REIMBURSEMENT DOLLARS     ( 1 )     ( 2 )     ( 3 )     ( 4 )     ( 5 )     ( 6 )     ( 7 )     ( 8 )     ( 9 )
REGULAR APPROPRIATIONS ONLY          FY 1983                       FY 1984
NOA ONLY                            FINAL UPLAN                   12/1 UPLAN
GROUP GRANT PES-RPIO 97
                                  TOTFTE    TOTALS$             TOTFTE    TOTALS$             4-1=7     5-2=6
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  T HAZ SUB RESP TR FD             24.5    6,438.5               42.5    8,780.7              18.0    2,342.2

 Y105 HAZARDOUS SUBSTANCE NON      24.5    6,438.5               42.5    8,780.7              18.0    2,342.2

  T HAZ SUB RESP TR FD                       131.7                                                    -131.7

 Y517                                        131.7                                                    -131.7

Y SUPERFUND                        24.5    6,570.2               42.5    8,780.7              18.0    2,210.5
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                                  UNITED STATES ENVIRONMENTAL PROTECTION AGENCY                              PAGE    16
                                      BUDGET ANALYSIS RESOURCE SYSTEM                                           12-02-83
                                                                                                              DAVE-4
                            FY 1983 FINAL OPERATING PLAN VS FY 1984 12/1 OPERATING PLAN                   TIME 15143134
                                          BY DUMEDIA, DUCODE, APPROP
                                                                                                                        .
                                                                                                  (MARS 01)
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EXCLUDE REIMBURSEMENT DOLLARS      ( 1 )      ( 2 )       ( 3 )      ( 4 )      ( 5 )      ( 6 )      ( 7 )      ( 8 )      ( 9 )
REGULAR APPROPRIATIONS ONLY           FY 1983                            FY 1984
NOA ONLY                             FINAL UPLAN                        12/1 UPLAN
GROUP GRANT PFS-RPIO 97
                                   TOTFTE     TOTALS$                TOTFTE     TOTALS$               4-1=7      5-2=8
---------------------------------------------------------------------------------------------------------------------

       GRAND TOTAL                1,862.6  226,183.0                1,787.4  244,742.8                -75.2   18,559.8
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Senator Baucus:

3) Could you elaborate on the budget reductions to control Technology Development.

-- What projects are being terminated ?

-- Is there any indication that these projects will be assumed by anyone in the private sector ?

Over the past several years our philosophy has been that hardware and equipment development should be preformed by the private sector and driven by the natural market forces. As a result, the engineering activities within R&D have been moving away from hardware development and moving more toward evaluation of emerging technology. In order to assure that gaps in technology are not created we are working more closely with industry to help define the most realistic role for both the private sector and ourselves.

There occasionally are exceptions. They arise when the risk is determined to be too great for the private sector to take. An example of this is our current work on Limestone Injection of Multi Stage Burners, commonly referred to as LIMB.

The shift in emphasis has not resulted in the termination of any hardware oriented grants, contracts or cooperative agreements. However, new starts in these areas are being significantly reduced while hardware development efforts are being brought to an orderly close.

4. You indicate that $1.8 million will be spent on the non-ionizing radiation program in FY-84. Does this indicate that the Administrator has decided to continue this program?

Yes. The preparation and review of the assessment document highlighted certain issues where additional data could lead to improved guidance. The program has been continued to resolve a limited number of very specific issues. The major issues are:

1. the paucity of data under conditions other than continuous-ware whole-body exposure,

2. the significance, if any, of recently observed central nervous system effects from low level exposure,

3. the risks of exposure to frequencies outside the range of the present guidelines (especially 60Hz), and

4. long-term low level effects.

QUESTION FOR DR. RIORDAN--EPA
Submitted by Senator Baucus

Question 5a.

Administrator Ruckelshaus has expressed interest in developing a systematic method for risk assessment. Is the Office of Research and Development doing any work toward development of such a system?

Response to Question 5a.

The Environmental Protection Agency adopted guidelines for the scientific evaluation of cancer risks in 1976. In general, the Agency is continuing to use this approach in its carcinogen risk assessment activities. In addition, the Agency proposed guidelines for assessing mutagenic risk in 1980 and is currently using these guidelines for mutagenic assessments.

The Administrator has convened Agency task groups to make recommendations on integrated management strategies for risk assessment, risk management, interagency cooperation, approaches for managing major issues that are cross-cutting or of high visibility, and toxics integration issues. The Office of Research and Development is represented on all task groups and chairs the group on risk assessment. This group recently recommended updating risk assessment guidelines for carcinogenicity, revising the proposed mutagenicity risk assessment guidelines, revising the exposure assessment guidelines, and developing guidelines for reproductive effects (teratogenicity, male and female infertility), systemic effects, and complex mixtures. The purpose of these guidelines is to provide a consistent approach to the evaluation of scientific data as a basis for implementing the Agency's regulatory responsibilities.

In addition, the Office of Research and Development is contributing to the interagency work group chaired by the Office of Science and Technology Policy. The intent here is to review and summarize the state-of-science for identifying potential human carcinogens and derive a set of general principles to help guide regulatory agencies in evaluating carcinogenic data as a basis for making regulatory decisions.

Research recommendations are developed during the risk assessment process and are incorporated into our health and risk assessment documents. The research appropriate to risk assessment, when completed, will be used to update and modify current risk assessment procedures. Where there is insufficient or inadequate information, additional tests are identified and protocols developed to fill this void.

Response to Senator Baucus

5b. Q: Could you comment generally on the priorities the Administrator has identified for the Office of Research and Development?

A: The overriding priority the Administrator has set for the Office of Research and Development (ORD) is to improve the scientific quality, relevance and usefulness of our research products. This will ultimately improve the scientific basis behind EPA's regulatory and enforcement actions. There are several ways in which we are pursuing this objective.

One of my goals is to improve the quality and validity of the data we generate by implementing and monitoring a vigorous quality assurance (QA) program. An Agency-wide QA policy committee has been established to oversee QA efforts and recommend any necessary remedial measures. In addition, we are writing a manual that will carefully describe the specific roles that managers within ORD and throughout EPA must assume in implementing QA procedures.

In another move to improve the scientific quality of our research, we have instituted a laboratory peer review program. Major portions of the research program are now being peer reviewed on a systematic basis in accord with established guidelines.

We aim to improve the timeliness and usefulness of our research products through several internal management reforms. First, we have modified our planning process to strengthen further the linkage between the research functions and the client program offices in EPA. In consultation with the client offices, we have developed broad research strategy documents for each of EPA's major regulatory responsibilities (air, water, toxics and pesticides, hazardous waste), as well as for energy, including acid deposition, and for Superfund support. These strategies document a mutual understanding of what research products will be provided when, as well as provide the basis for formulating our budget requests.

Second, we are implementing an automated information system which clearly links our strategic research objectives to planned accomplishments and subsequently to specific research outputs. This system will provide us and our client offices with comprehensive status reports on research in progress, and our researchers will be accountable for providing needed research products on a timely basis.

Finally, we are instituting management changes in our research centers and grants programs to focus more effectively on long-term Agency needs. These changes will include improved definition of long-term needs and a special emphasis on integrating products of the grants programs into Agency needs.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Office of the Secretary

Washington, D.C. 20201

FOR RELEASE ONLY UPON DELIVERY

STATEMENT
OF THE
U.S. PUBLIC HEALTH SERVICE
DEPARTMENT OF HEALTH AND HUMAN SERVICES

PROVIDED TO THE

SUBCOMMITTEE ON TOXIC SUBSTANCES
AND ENVIRONMENTAL OVERSIGHT
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

OCTOBER 17, 1983

Mr. Chairman and Members of the Subcommittee:

It is a pleasure to be here this morning to describe the environmentally related research and development activities of the Department of Health and Human Services (DHHS). I am Dr. David P. Rall, Director of the National Institute of Environmental Health Sciences, (NIEHS), the National Institutes of Health (NIH), and the National Toxicology Program (NTP). I am accompanied by Dr. Richard H. Adamson, Director, Division of Cancer Cause and Prevention of the National Cancer Institute (NCI), NIH; Dr. Vernon N. Houk, Director, Center for Environmental Health, Centers for Disease Control (CDC); Dr. J. Donald Millar, Director, National Institute for Occupational Safety and Health, CDC; and Dr. Robert J. Scheuplein, Acting Deputy Director for Toxicological Sciences, Bureau of Foods, Food and Drug Administration (FDA).

Role of the Department of Health and Human Services

The role of this Department in environmental research is focused primarily on the protection of human health from the adverse effects of exposure to potentially hazardous substances in the environment. Our activities in this regard encompass the identification of such substances, developing an understanding of their mechanisms of action and finding more effective methods to respond to or ameliorate their damage to the human system. With the Subcommittee's permission, I would like to submit brief descriptions of DHHS environmental health research and other environmentally related programs for the record and use the time available to highlight Department activities in this area that are reflective of our research priorities and objectives. I will also discuss coordination with other Federal agencies and information dissemination to the public health and private medical communities.

Significance of Environmental Health Research

Environmental health research is a relatively new field. Before the 1960s there was little knowledge or understanding that environmental chemicals such as pesticides presented potential threats to the environment and the human body. Rachael Carson's Silent Spring, published in 1962, was the beginning of an educational process for both scientists and the general public. The book vividly illustrated the threat to the environment from the persistent pesticides upon which we had become so dependent in the post-war period. Silent Spring presented two concepts that were then new to most of us: long-term or chronic toxicity is as serious to human health as acute toxicity; and chemicals can persist both in our environment and our bodies. In the human body they can accumulate in fat tissue and in other human organ systems and result in severe health problems decades after exposure.

In just over twenty years, environmental health research has evolved into a complex, sophisticated field. Today we know that of the at least 65,000 chemicals used commercially in this country, most can be used safely. Our task is to identify those relatively few that can cause disease and death.

Environmental health scientists, given adequate time and resources, can get quite good information from animal toxicology studies--the primary tool in the field. In some cases we have good corresponding human health effects data from epidemiologic studies. However, there remains great difficulty in getting adequate measures of human exposure. Thus, it is usually a problem to correlate various levels of exposure with specific estimates of health risks. We continue to work towards development and refinement of our environmental health research tools so that public health and environmental protection policies are based on increasingly complete, precise information.

It must be noted here that in addition to environmental chemicals, research advances also point increasingly towards the role of social, cultural and dietary factors in disease induction. Recent data from NCI indicate that lifestyle is an important factor in various cancers occurring in the population.

Research and Development Activities

The environmental health research and development activities of the Public Health Service (PHS) range from basic research to chemical testing and methods development, criteria recommendation, and technical assistance to other Federal, state and local organizations. Programs now supported and conducted by PHS components demonstrate this.

Of the above activities, the National Institutes of Health has the largest basic research and development effort in environmental health within the Department. The various Institutes, in particular the NIEHS and NCI, are involved in a wide range of such activities including; studies of the structure of DNA and the functioning of genes to increase understanding of how the genetic code operates and how damage from chemicals can cause cancer, birth defects and other health problems; development of sensitive procedures to detect the binding of environmental carcinogens to DNA of individuals potentially exposed to such substances; use of monoclonal antibodies to relate an individual's enzyme activity to his sensitivity to environmental carcinogens, making it possible to identify populations which are especially sensitive to environmental agents; understanding of the effects of toxic substances on the process of growth, maturation and adaptation in developing organisms; investigation of the effects at the molecular level of certain industrial pollutants such as carbon monoxide, silica and asbestos; exploration of the role of environmental and genetic factors in oral-facial malformations; and studies of the neurotoxic effects of heavy metals and artificial food colors.

At the Centers for Disease Control (CDC) the principal focus for environmentally related research is the National Institute for Occupational Safety and Health (NIOSH). NIOSH performs research on safety and health problems in the workplace and makes recommendations to the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA) for standard setting in the workplace environment. NIOSH also participates in CDC's performance of toxicological studies on problems of potential public health significance. CDC's recently established Center for Environmental Health (CEH) investigates outbreaks of disease and health risks potentially related to environmental hazards. Recent CEH studies included dioxin exposure in Missouri, health effects of lead exposure near smelters and

PCB exposures, and the Love Canal cytogenetic study. CEH also measures public health problems related to natural disasters and injuries, and is establishing population-based surveillance of disease and reproductive outcomes likely to be associated with environmental hazards.

The Food & Drug Administration (FDA), develops multiresidue surveillance analytical methods for the detection of pesticides in foods and for food contaminants such as industrial chemicals. They also measure the toxic properties of food additives and specific components of food, both natural and man-made. Much of this latter work is under way at the National Center for Toxicological Research (NCTR).

The National Center for Health Statistics (NCHS) has several major data collection programs including ones which are extensively used by, and developed in response to, other PHS components. These include: the National Vital Statistics System and surveys that obtain data from extensive physical examinations and personal interviews, such as, the National Health and Nutrition Examination Survey and the National Health Interview Survey.

The Alcohol, Drug Abuse and Mental Health Administration (ADAMHA) supports research regarding the psychological response(s) to various disaster situations including chemical waste crises; for example, the situation in Missouri where dioxin-contaminated waste oil has been the source of extensive environmental contamination.

Since 1980 we estimate that funding for environmental health research has increased by [illegible].62 million. Specifically: $348 million was funded in fiscal year 1980; $363.8 million in fiscal year 1981; and $385.4 million in fiscal year 1982. Estimates for fiscal year 1983 are $399 million. Estimates for fiscal year 1984 are $418.7 million.

Other Environmentally Related Activities

In the Department there are other environmentally related activities that are important. DHHS has health related responsibilities mandated by the Comprehensive Environmental Response, Compensation & Liability Act (Superfund). The Agency for Toxic Substances and Disease Registry (ATSDR) has been established in PHS in response to this mandate. Agency staff provide assistance to the Environmental Protection Agency (EPA) in documenting human exposure and adverse health effects in populations near waste sites. They have looked at many of the EPA-designated priority hazardous waste sites to determine if there is evidence of exposure and disease that could possibly be related to those dump sites. NIOSH is also working with EPA on the design and monitoring of worker health and safety plans at priority hazardous waste sites.

Agency Interaction and Coordination

The Department is pleased with the spirit of interaction between between DHHS and EPA. A recent example is the designation of an NIEHS intramural scientist, Dr. John Moore, and an NIH grantee, Dr. Bernard Goldstein, to senior EPA positions. The central coordinating mechanism within the Department is the Committee to Coordinate Environmental and Related Programs (CCERP). This Committee serves as an important means for state of the art analyses, information exchange and provision of advice to the Department on environmental health, toxicology and related programs. Its membership includes representation from each agency within the Department supporting or conducting activities in this area. Representatives from EPA, OSHA, the Consumer Product Safety Commission (CPSC), the Department of Energy (DOE) and the National Science Foundation (NSF) are among its liaison members.

The National Toxicology Program combines selected toxicological research and testing from resources from NIH, FDA/NCTR, CDC/ NIOSH, ATSDR and health regulatory agencies: CPSC, EPA, FDA, and OSHA. This provides a direct mechanism for interaction between PHS research and testing and the regulators. NTP annually issues a "Review of Current DHHS, DOE and EPA Research Related to Toxicology." This report, which I would like to submit for the record, served as the source for much of the information on Department environmental research and development activities I have described to you today.

The NCI maintains a cooperative agreement with the International Agency for Research on Cancer (IARC) which supports a monograph series entitled "Evaluation of the Carcinogenic Risk of Chemicals to Humans." These monographs have become the international reference standard and are widely used by Federal research an regulatory agencies in the U.S. for the evaluation of environmental cancer hazards.

The PHS also provides assistance to the regulatory agencies by keeping their staffs apprised of the results of research conducted or supported in the area of environmental health research. While the principle method for broad distribution of research results is the published literature, the PHS routinely provides the agencies with accepted journal articles, reports, and summaries of new research findings. In addition, scientists often present preliminary data at scientific meetings prior to publication of final results, thus making information available several months earlier than would otherwise be the case.

Information Dissemination

The National Library of Medicine's (NLM) Toxicology Information Program provides, among other activities, a central source for the collection and dissemination of information on environmental agents. It has lead responsibility within the Department for coordinating efforts in this regard. Recently, as a result of increased information needs in carrying out its Superfund responsibilities, ATSDR has asked NLM to expand its Toxicology Data Base to include additional chemicals and additional types of data available on each chemical.

The Interagency Collaborative Group on Environmental Carcinogenesis, chaired by a representative of the NCI, serves as a forum for exchanging information among member organizations including: NCI, NIEHS, the FDA, the United States Department of Agriculture (USDA), the Council on Environmental Quality (CEQ), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the Department of Transportation (DOT), NSF and others involved in environmental carcinogenesis research, risk assessment, and regulation.

Further, information generated by Department researchers is being utilized by the environmental regulatory agencies. OSHA in its recent notice to revise occupational exposure standards to ethylene dibromide (EDB), cited NCI and NCI/NTP conducted carcinogenesis studies as evidence of the potential for EDB to induce cancer in animals. In regulatory notices, EPA also cited an NCI chronic animal study in its assessment of health risks from EDB exposure. Another very recent example is EPA's and OSHA's announcement of a joint call for information to consider regulation of 4, 4'-methylenendianiline (4, 4'-MDA). They relied on the National Toxicology Program conducted studies that found the substance to be a carcinogen in animals.

Conclusion

In conclusion, the Department of Health and Human Services has a variety of mechanisms in place to address the problems associated with the identification of hazardous substances in the environment, to determine the mechanisms of action, to develop means to reduce their damage to human systems, and to provide this basic information to the regulatory agencies. By January 1985, NIEHS will have completed a Third Task Force on Research Planning and the Environmental Health Sciences. With these efforts the Department will continue to make progress in charting the research direction of the environmental health sciences.

I will be happy to answer any questions you may have.

ENVIRONMENTAL HEALTH RESEARCH AND DEVELOPMENT
AND
OTHER ENVIRONMENTALLY RELATED ACTIVITIES
IN THE
DEPARTMENT OF HEALTH AND HUMAN SERVICES

OCTOBER 1983

TABLE OF CONTENTS

- Agency for Toxic Substances & Disease Registry

- Alcohol, Drug Abuse, and Mental Health Administration

- Centers for Disease Control
  - Center for Environmental Health
  - National Institute for Occupational Safety and Health

- Food and Drug Administration
  - Bureau of Foods
  - National Center for Toxicological Research

- National Center for Health Statistics

- National Institutes of Health
  - National Cancer Institute
  - National Eye Institute
  - National Heart, Lung, and Blood Institute
  - National Institute of Child Health and Human Development
  - National Institute of Dental Research
  - National Institute of Environmental Health Sciences
  - National Institute of Neurological and Communicative Disorders and Stroke
  - National Library of Medicine
  - Division of Research Resources

- Coordinating Mechanisms
  - Committee to Coordinate Environmental and Related Programs
  - National Toxicology Program

Environmentally related activities as defined for purposes of this hearing refer primarily to efforts related to the identification, understanding, and response to adverse human health effects resulting, or potentially resulting, from involuntary exposure to chemical agents in the environment. Specifically excluded from this are activities primarily focused on radiation or lifestyle factors such as smoking, nutrition or over the counter and prescription drug use or substance abuse.

For the Subcommittee's information, the following also include other Departmental environmentally related activities. Although not strictly research and development, these efforts are directly related to EPA's and other environmental regulatory agencies' responsibilities for control of toxic substances.

AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

ATSDR was created on April 12, 1983 in response to the mandate of Section 104(i) of the Comprehensive Environmental Response, Liability, and Compensation Act (42 U.S.C 9601 et. seq.). This newest Agency of the Public Health Service coordinates the provisions of CERCLA which are delegated to the Secretary of Health and Human Services by the President in Executive Order 12371 and carried out through the appropriate components of the Public Health Service.

Specifically, ATSDR provides leadership and direction to programs designed to protect the public health from exposure to hazardous substances and worker safety and health against hazards associated with hazardous waste removal and remedial or other response actions. The primary function of ATSDR is to provide a central focus to insure that the resources available in PHS are directed to these areas:

1. In cooperation with States and other federal and local official agencies, collects, maintains, and analyzes information relating to serious diseases and mortality and information relating to human exposure to toxic or hazardous substances and establishes appropriate registries necessary for long-term followup or specific scientific studies.

2. Establishes and maintains an inventory of literature, research, and studies on the health effects of toxic substances.

3. In cooperation with States and other agencies of the Federal Government, establishes and maintains a complete listing of areas closed to the public or otherwise restricted in use because of toxic substance contamination.

4. In cases of public health emergencies or other instances of actual or probably human exposure, assists, consults, and coordinates with private or public health care providers in the provision of medical care and testing of exposed individuals, including the collection and laboratory analysis of specimens as may be indicated by the specific exposure incident.

5. Conducts periodic surveys and screening programs to determine relationships between exposure to toxic substances and illness.

6. Plans and implements the health-related activities authorized by CERCLA.

7. Develops scientific and technical procedures for evaluating public health risk from hazardous substance incidents and for developing recommendations to protect the public health.

8. Coordinates these recommendations with the PHS agencies

responsible for environmental health programs, and with appropriate Federal, State, and local public health and environmental protection officials.

9. Provides medical, epidemiological, technical, and administrative advice and consultation to protect public health and worker safety and health in instances of exposure or potential exposure to hazardous substances, and arranges for program support to ensure adequate response to public health emergencies declared under the authority of CERCLA.

ADAMHA supports research on factors in the environment affecting mental health.

ADAMHA currently supports a project to assess the effects of exposure to disaster and relocation as they affect the development of symptoms of mental illness. Specific aims are to study whether different kinds of emergencies (flood and/or chemical waste) and community response (relocation versus community stability) differentially affect the long-term mental health consequences of exposure to disaster.

This project involves funding the St. Louis Epidemiology Catchment Area for a third phase of data collection. The St. Louis ECA includes areas of Missouri currently experiencing exposure to highly toxic levels of dioxin. This ECA developed a measure of post-traumatic stress syndrome which was administered during the second phase of collection (FY 1983). This collection period was just prior to extensive flooding in the Missouri area. The St. Louis ECA thus represents a unique opportunity to study the victims of an emergency where both pre- and post-disaster measures of stress are potentially available.

At present there are significant gaps in the available research on emotional response to disaster. The severity and duration of psychological disorder resulting from exposure to environmental hazards is still a matter of debate. Also unknown is whether alternative community responses to disaster can mediate the impact of traumatic events on the victim.

Investigators in this field have suggested that two factors may be of primary importance in determining the post-trauma emotional response of victims: the origin of the disaster (natural versus manmade) and the social supports available to the victim. The St. Louis ECA permits the test of two hypotheses frequently offered by research investigators: that long-term negative psychological consequences are more likely to occur following manmade disasters (in this case, dioxin) and community disruption (relocation), than following natural disasters (flood) and conditions of ongoing social support (community stability). The third phase of data collection involves areas exposed to both, one or neither type of disaster as well as communities which do and do not relocate. These predictions may therefore be empirically tested, using a survey which encompasses a wide range of diagnostic and behavioral indicators of reactions to trauma.

CENTERS FOR DISEASE CONTROL

Center for Environmental Health

The Center for Environmental Health carries out projects ranging from field investigations of cancer case clusters or multiple case cancer families to long-term case control or cohort studies that frequently involve collaboration with universities and various state and Federal agencies.

Recent activities have involved studies of health effects of toxic agents including heavy metals, pesticides, polybrominated biphenyls, polychlorinated biphenyls, and complex mixtures arising from toxic waste disposal. Other studies have been directed at respiratory and other health effects secondary to indoor air pollution.

Among other activities CEH examines the environmental causes of low birth weight, infant mortality, and chronic disabling conditions of childhood.

National Institute for Occupational Safety and Health

The primary responsibility of NIOSH is to provide research and standards-setting support to the Occupational Safety and Health Administration and to the Mine Safety and Health Administration.

NIOSH recommends health and safety standards to OSHA for regulatory action and enforcement. Subjects for recommended standards are based on severity of response, population at risk, toxicity, availability of an existing standard, and advice from Federal agencies and involved industry, organized labor, and professional groups. These recommendations include exposure levels, engineering controls, personal protective equipment, medical surveillance, labeling, training and and record keeping provisions.

NIOSH research addresses the development or modification of criteria for recommended occupational safety and health standards. It is directed at assessing interactions between chemical and physical agents, at developing new monitoring techniques and analytical methods, and at methods of diagnosing and preventing specific occupational diseases. Examples of research include:

- Surveillance, control technology assessment, and laboratory research aimed at identification and prevention of occupational diseases and injuries;
- Development of sensitive and specific diagnostic tests for occupational disease;
- Development of personal protective equipment to reduce exposure to industrial chemicals;

- Studies to evaluate selected workplace environments (coal mines, cotton processing, as examples) in order to assess the adequacy of existing exposure standards;
- Industry wide epidemiological and industrial hygiene studies to determine potential association between disease and injuries and occupational exposures.

NIOSH provides a variety of technical assistance to employers, employees, universities, and professionals in the field of occupational safety and health. These include:

- Performing industrial hygiene surveys and medical evaluation at individual worksites to determine current occupational hazards and toxic exposures;
- Chest x-ray examinations and autopsies of coal miners;
- Maintaining a program to certify physicians who provide medical interpretations of chest radiographs submitted to the Institute under the provisions of the miner examination program mandated by law;
- Testing and certification of personal protective equipment (e.g. respirators).

FOOD AND DRUG ADMINISTRATION

FDA research activities that pertain to the relation between environmental factors and disease as defined in this report are primarily in the Bureau of Foods and at the National Center for Toxicological Research.

Bureau of Foods: The Bureau conducts or supports research to develop:

- Multi- and single residue analytical methods for pesticides, dioxins, and other industrial chemicals;
- Multi- and single element analytical methods for toxic elements and methods for the determination of the chemical forms of toxic elements present in foods;
- Analytical methods for the detection of mycotoxins, plant toxins, and seafood toxins in foods;
- Analytical methods for detection and measurement of food additives;
- Methods that measure the toxic properties of food additives and contaminants especially related to diseases, such as carcinogenesis, with long latency periods.

National Center for Toxicological Research

The major emphasis of the NCTR program is to provide basic research support to the FDA and other government agencies focusing attention on critical problems in toxicology, so that regulatory actions can be based upon sound scientific evidence. To implement this program, the NCTR effort is concentrated in chemical evaluation, test/methods development, basic research activities, and extrapolation.

In chemical evaluation NCTR determines dose-response toxic effects in multiple organs/tissues, carcinogenic potential of selected chemicals, and effects of environmental factors on chemical carcinogenesis.

The methods development research areas have instituted program to assess genetic or specific target tissue damage following prenatal or postnatal chemical exposure; implement more efficient *in vivo* toxicity assays; develop more reliable and economic *in vitro* methods for predicting the genotoxic potential of chemical agents; evaluate current teratology testing methods and implement new or improved procedures; investigate new procedures for the quantitation, analysis, and separating of toxic chemicals and provide sensitive methods for elucidating chemical structure; and refine assays for the evaluation of toxic agents on the immune system.

The basic research mission of NCTR seeks to explain how toxic chemicals produce cellular injury or induce toxic changes in cells. Such understanding may result in the development of new techniques for prevention of disease at the subcellular levels.

NCTR uses this research data for the extrapolation of potential human health risks of environmental contaminants.

NATIONAL CENTER FOR HEALTH STATISTICS

14 major data collection programs produce morbidity and mortality data on a wide range of diseases. These data systems frequently provide basic data for use by other Federal agencies in their research on the potential relationship between environmental factors and disease.

Data collection programs of special interest include:

1. National Health and Nutrition Examination Survey (NHANES):
   - The NHANES I Augmentation Survey (1974-75) included a Water Sample Collaborative Study with the NHLBI and EPA. Its purpose was to determine possible relationships of bulk constituents, hardness, and trace metals in household tap water with certain risk factors of cardiovascular disease. The data will be analyzed for possible associations of these drinking water constituents with cardiovascular disease, cancer, hypertension, and some other conditions, such as arthritis, urinary problems, and neurologic abnormalities.
   - National Health and Nutrition Examination Survey II (NHANES II, 1976-80) continued the data collection efforts of NHANES I with some notable additions. Specific environmentally related data collected in this survey included levels of lead in whole blood; carbon monoxide levels in the blood (carboxyhemoglobin); pesticide residues in the serum (such as DDT, dieldrin, mirex, hexachlorobenzene, among others); and pesticide residues in the urine (such as pentachlorophenol, silvex, DMTP, among others)
   - The Hispanic Health and Nutrition Examination Survey (Hispanic HANES) began in July 1982 and will be completed by late 1984. As in the previous NHANES II, there will be samples taken of blood and urine to measure body burdens of lead, carbon monoxide, and selected pesticide residues and metabolites.
   - The NHANES I Epidemiologic Followup Survey (1982-1983) has interviewed adults (ages 25-74) who were examined in the first National Health and Nutrition Examination Survey 1971-75. Funds are being provided by the National Institute on Aging, other NIH Institutes, and other Federal agencies. The followup will focus on how factors previously measured in the earlier study relate to health conditions that have developed since that time. Specific items on the questionnaire that relate to environmental factors include questions on skin cancer, cigarette smoking, source of drinking water, occupational exposure to dusts, fumes, or vapors, and frequency of consumption of selected foods. All deaths of this population will be identified.
2. 1980 National Natality Survey (NNS) and 1980 National Fetal Mortality Survey NFMS): The 1980 NNS is a vital statistics followback survey and the 1980 NFMS is parallel in design and content to the NNS. Data was obtained from mothers, physicians, hospitals, and other medical sources

which provided ionizing radiation to the mother during pregnancy. Among the items on environmental factors are questions on smoking, occupation of mother and father, and exposure to radiation and certain household chemicals such as pesticides. Data are being analyzed to determine possible relationships of these environmental factors with birth abnormalities and fetal mortality.

3. National Health Interview Survey (NHIS): The NHIS provides national data on the incidence and prevalence of disease and the extent of disability and the use of health services of the U.S. population. There is an agreement with NIOSH for joint exploration of the analytic potential of the possible relationships between occupational exposure and environmentally related disease. .In addition, the NHIS data is being used in the analysis of photochemical oxidant data to determine health effects of exposure to these air pollutants.

4. National Mortality Data
   - o General Mortality Statistics
     NCHS mortality statistics, based on the national vital registration system and implemented under state law, is the major national source of data for determining health effects on the environment. These data were recently used to present geographic distributions of mortality in two atlases published by NCI.
   - o National Death Index (NDI)
     The NDI is a central, computerized file of data from death certificates compiled from computer tapes obtained by NCHS from state offices of vital statistics. Based on the contact NDI users can contact appropriate state offices to procure copies of death certificates or specific statistical information such as cause of death.
   - o Occupational Mortality Statistics
     With encouragement by NCI, a collaborative project of NCHS, NIOSH, and the Census Bureau has been initiated to encourage the states to code occupation and industry on the death certificate. This will result in the development of a national data based for occupational mortality statistics.
   - o Multiple Cause of Death Statistics
     Mortality data for 1968-1979 are now available on public use data tapes for all medical conditions reports on the death certificate in addition to the underlying cause of death. This permits analysis of associated conditions which may reflect environmental influences.
   - o Current Population Survey (CPS) Project
     NCHS, in cooperation with NHLBI and the Census Bureau, will select cohorts of persons from past CPS samples to be matched to the NDI for investigating the relationship of mortality to occupation and industry and other sociodemographic variables.

NATIONAL INSTITUTES OF HEALTH

National Cancer Institute

The NCI is the lead Federal agency in cancer research, responsible and accountable for the investment of progress towards developing the means for reducing the incidence, morbidity, and mortality of cancer. The Institute coordinates the National Cancer Program (NCP), which encompasses a variety of programs sponsored by NCI, other branches of the National Institutes of Health (NIH), and Federal and non-Federal agencies.

Scientists generally recognize that the majority of human cancers occur as a result of environmental influences including lifestyle factors such as cigarette smoking, dietary factors including fat and fiber content, consumption of alcoholic beverages, and exposure to sunlight. The single most identifiable factor in causing cancer is tobacco smoking, which accounts for approximately 30 percent of the cancer in the United States. It is estimated that dietary factors are associated with an additional 35 percent of cancer and alcoholic beverage consumption 3-4 percent. Other identifiable factors of cancer causation include chemical exposures in the workplace, pollution, viruses, drugs and geophysical factors. This description primarily is concerned with environmental research that relates to chemical exposures and prevention of related disease.

Currently, the Institute is conducting, or funds through grants and contracts, laboratory and epidemiological studies on environmental carcinogens, including tobacco, naturally occurring carcinogens in food and those formed during food processing, pesticides, low level radiation, synthetic estrogens, asbestos and other fibers, halogenated hydrocarbons found in drinking water, and other pollutants. In other programs, intra- and interspecies variability is under investigation in order to elucidate the causes of species-dependent responses to carcinogen exposure; these efforts involve studies on carcinogen metabolism, pharmacokinetics, carcinogen DNA adduct formation and DNA repair. In addition, food additives and natural components of foods are being evaluated for their ability to inhibit environmental carcinogens. NCI also acts as an information center on cancer and has developed a data bank on international cancer research.

Intramural Research in Environmental Carcinogenesis

The Carcinogenesis Intramural Program of NCI plans, directs, and conducts a basic and applied research program on the occurrence and inhibition of cancer caused or promoted by chemical or physical agents acting separately or together, or in combination with biological agents. In addition, it develops and conducts programs in the areas of environmental carcinogenesis and related toxicology, metabolism, chemistry, cell biology, and experimental tumor pathology.

The major objectives of this program are to identify the determinants of human cancer, to understand their mechanisms of action and to develop and evaluate measures that will arrest, reverse, or otherwise interfere with the initiation or progression of the cancer process. These objectives include the development of optimum procedures for culturing epithelial cells from various animal and human tissues and the evaluation of the effects of environmental carcinogens and co-carcinogens on those cells; the development of sensitive procedures to detect the covalent binding of chemical carcinogens to DNA of individuals potentially exposed to such substances; to correlate individual differences in metabolism of environmental carcinogens with susceptibility to tumor induction; identification of tumor promoters and anti-promoters and studies on their mechanism of action and interaction with biologically important macromolecules; identification, isolation and characterization of new tumor inhibitory substances and the synthesis and evaluation of analogs of known inhibitors; and studies on perinatal carcinogenesis resulting from environmental or occupational exposures.

The NCI Biometry and Epidemiology Program includes epidemiologic, demographic, statistical and mathematical research on the cause, characteristics, distribution and occurrence of human cancer. This program also studies mortality and morbidity statistics in order to make correlations with demographic and environmental variables to formulate clues to cancer etiology and performs field studies in an effort to detect the specific environmental and host determinants of cancer.

A major emphasis has been placed on a new NCI research area called "biochemical and molecular epidemiology." This area involves the incorporation of newly-developed biochemical techniques into traditional epidemiologic investigations and the refinement of these procedures into safe, accurate, reliable and informative adjuncts to human investigations. These techniques are being used to accurately characterize exposure to environmental/occupational carcinogens and for identifying measures which may prevent or reverse the carcinogenic process. The primary goal in these investigations is to identify individuals at increased cancer risk by obtaining pathobiological evidence of high exposure of target cells to carcinogens and/or increased susceptibility due to inherited or acquired host factors.

Extramural Research in Environmental Carcinogenesis

Environmental research and related activities supported by the extramural carcinogenesis program include grants and contracts for research on mechanisms of action of chemical and physical carcinogens, DNA damage and repair in carcinogenesis, inter- and intraspecies comparisons in the response to carcinogen exposure, the role of tumor promoters, hormones, and other cofactors in cancer causation, experimental approaches to the inhibition of carcinogenesis, and in vitro carcinogenesis studies on human cells, tissues, and subcellular fractions. The program also supports the synthesis, acquisition, and distribution of a considerable spectrum of chemical substances, critically needed in the field of carcinogenesis research.

Research in the area of molecular carcinogenesis include studies on the effects of carcinogens on cell macromolecules, studies on the cellular changes due to carcinogen or promoter exposure, and methods development. Projects focused on the macromolecular effects of carcinogen interaction include physical chemical and computer-aided theoretical studies on the conformational structure of carcinogen nucleic acid adducts; studies on the determination of DNA sequence and site specificity of carcinogen binding which may lead to gene mutations and genetic damage; studies on the alterations of nonhistone chromosomal protein, DNA methylation patterns, and DNA synthetic enzymes which result in altered gene expression; studies on changes in RNA transcription and transport and the alterations in the fidelity of DNA replication; studies in the repair of DNA damage and the isolation, characterization, and genetics of DNA repair enzymes; and studies on the isolation, genetics and regulation of carcinogen metabolizing enzymes.

The polycyclic aromatic hydrocarbons (PAHs) are under active study because many chemicals in this class are environmentally and occupationally important. The metabolic pathways have been elucidated for many of the compounds in the group, and molecular structure-activity studies are underway. Alkylating agents are also being evaluated in studies which are primarily concerned with the chemistry and metabolism of N-nitroso compounds. Of potential environmental importance is one new project where the ability of an environmental pollutant, nitrogen dioxide, to form N-nitroso compounds in vivo is being investigated.

In another area, studies are being directed at the experimental inhibition or modification of the carcinogenic process. Emphasis is being placed upon basic studies of mechanisms of anticarcinogenesis, and upon pharmacological and physiological intervention in the multi-stage carcinogenic process in experimental animal systems.

The Chemical Research Resources area of the NCI extramural program endeavors to make available to the cancer research community those critical resources which are difficult or impossible for most investigators to obtain on their own, but which are necessary for the pursuit of studies on the chemical and physical aspects of carcinogenesis. A major effort of this program has involved the synthesis and distribution of chemical carcinogens, derivatives, and metabolites for use as authentic research standards. The Chemical Research Resources program also monitors an instrument loan program, involving NCI-owned thermal energy analyzers, which are placed in laboratories around the world for studies on the environmental occurrence and relevance of N-nitroso compounds such as nitrosamines and nitrosamides.

National Eye Institute

Clinical evidence indicates that many drugs and chemicals can damage the eye. Of particular concern are the adverse effects of drugs and poisons on the cornea, lens, aqueous outflow channels, retina, and optic nerve. The latter two structures are particularly vulnerable to toxic insult.

The development of sensitive, noninvasive tests of visual function, new animal models of human ocular toxicity, and new tissue culture techniques gives cause for optimism that ocular toxicology, which is presently in its infancy, will develop rapidly and mature over the next few years. At present, most of NEI's support for toxicology is in basic toxicology research. A few projects are concerned with developing methods for evaluating toxicologic effects in the functioning eye and in isolated ocular tissues.

Although the National Eye Institute's support of research on ocular toxicity is modest at present, this field has been identified in the 1983 Report of the National Advisory Eye Council, Vision Research--A National Plan: 1983-1987, as one of the special importance. NEI expects that the highlighting of research priorities related to ocular toxicity in this he report will stimulate interest among vision research scientists in submitting applications for research grants in this field.

National Heart, Lung, and Blood Institute

During the last 10 years, the Epidemiology and Biometry Program of the Division of Heart and Vascular Diseases, NHLBI, has pursued several studies in relation to environmental pollution and heart disease. These have included: The Seattle Study of Trace Element Exposure, the drinking water component of the Health and Nutrition Examination Survey, and the Boston Study on Relation of Water Constituents to Health; a study of artificial fluoridation in relation to mortality from cardiovascular and other diseases; and investigations of methodological techniques for analyzing trace metals in water and biological samples. Other studies include investigation of water hardness and cardiovascular mortality using small-area data and city data that had been assembled previously; studies of occupational risk factors using a link between the current population survey fields and the National Death Index; and correlation of county mortality data with available environmental indices.

Research related to pulmonary diseases includes studies of: the effects of toxic environmental chemicals and tobacco products on the lung; comparison of the occurrence of obstructive lung diseases in areas of high versus low population; environmental factors that produce airway diseases; the occurrence of subclinical respiratory disease; the pathogenesis and pathobiology of mineral pneumoconiosis; the effects of pollutants on organotypic lung cultures; the effects of ozone on lung function, the biological effect of ozone, nitrous oxide, nitrogen dioxide, and tobacco smoke, airborne metals and lung permeability; epidemiologic studies of chronic lung diseases; and comparison of genetic and environmental influences on lung disease.

National Institute of Child Health and Human Development

NICHD supports a wide range of studies involving toxic substances.

Center for Research for Mothers and Children (CRMC): In the three branches of the CRMC, there is a continuous interest in research that seeks to understand the effects of toxic substances on the processes of growth, maturation and adaptation in developing organisms from prenatal stages to young adulthood. Concern extends to the women prior and during pregnancy and to the behavioral manifestations that may result from contact with noxious agents. Ongoing research examines the toxic and teratogenic effects of pollutants. Clinical research includes studies on the neurophysiologic and psychologic consequences of exposure to lead.

National Institute of Dental Research

As the primary sponsor of dental research in the United States, the National Institute of Dental Research maintains responsibility for improving oral health through increased knowledge of oral and dental diseases and disorders. Components of toxicology research, testing, and method development occur in isolated projects supported by the Institute. For example, testing for toxic effects is conducted when screening anti-caries and anti-plaque agents, sugar substitutes, and chemotherapeutic agents used in treating oral herpes, determining the influence of trace elements on tooth structure; or testing the biocompatibility of dental restorative materials. In the area of craniofacial anomalies, the NIDR is exploring the role of environmental agents and genetic factors in oral-facial malformations. Studies are underway to define the molecular basis for genetic predisposition to certain teratogens.

National Institute of Environmental Health Sciences

NIEHS supports and conducts research aimed at the development of knowledge basic to understanding of the processes by which human health can be adversely affected by the environment. This research concentrates on recognizing, identifying, and investigating the environmental factors that may have deleterious effects on population groups, on quantifying those effects, and on understanding the mechanisms of action of toxic agents on biological systems. These efforts provide information that serves those charged with preventing and treating environmentally related disease, as well as agencies responsible for regulating exposure to hazardous substances.

The NIEHS Extramural Program is responsible for grant support of university based, investigator initiated environmental health research. NIEHS provides long-term stable core support for broadly based multidisciplinary research and training programs focused on a variety of environmental health problems. These multidisciplinary Centers serve as national resources for research in such health problems as air, water, and food pollution; occupational and industrial health and safety; heavy metal toxicity; agricultural chemical hazards; the relationships of the environment to cancer, birth defects, behavioral anomalies, respiratory and cardiovascular diseases, and diseases of other specific organs; and basic aspects of toxicity mechanisms and body defense mechanisms.

The Intramural Research Program aims to provide the kinds of information that will have explanatory and predictive value in utilizing experimentally determined toxicity. The conduct of this research requires the development of sensitive chemical analyses that employ advanced spectrometric and physical separation techniques. Application of these methods permits characterization of the hazardous chemicals to which populations are exposed, definition of the chemical transformations as they lead to toxic effects, and identification of specific molecular changes in cells and tissues that are the consequence of damage by toxic chemicals.

The expression of toxic chemical damage in organ systems is frequently detected long after exposure, at high doses of chemicals, and after an irreversible effect has been achieved. By developing knowledge of molecular and cellular events that occur closer to the biological onset of disease and by identifying sensitive criteria of damage that can be used to detect harmful exposure, the utility of experimental toxicological systems will be increased. In addition, a more complete understanding of the detailed abnormal processes that correspond or differ in animal and human cells will increase the confidence of an experimentally based analysis of risk. In this context, the IRP focuses its efforts on the study of genetic mutations, neurobehavioral effects, reproductive abnormalities, and cellular toxicology of the lung.

The Toxicology Research and Testing Program is essentially the NIEHS contribution to the National Toxicology Program (NTP) and constitutes the NIH component of the NTP, composing approximately 87 percent of the total NTP resources. TRTP emphasizes three major areas: test methods development/validation, toxicological characterization of chemicals, and testing of chemicals for potential adverse effects including carcinogenic, genetic, and reproductive outcomes.

Newer or refined test methods are being explored in order to develop more accurate, specific, and rapid procedures to characterize and predict potential toxic effects for humans from chemical exposures. The TRTP emphasis on testing, test development, and associated research does not imply flaws in traditional toxicology and regulatory requirements, but reflects rapid advancements in testing methodology and expanding boundaries of scientific knowledge.

The Biometry and Risk Assessment Program plans and conducts basic and applied research in the area of health risk assessment, biostatistics, biomathematics, and epidemiology. The elevation of these activities to program status reflects the Institute's growing interest in the various research issues and practical problems associated with the assessment of potential human health risks incurred as a result of exposure to hazardous environmental agents.

National Institute of Neurological and Communicative Disorders and Stroke

Toxicology research involving environmental chemicals is not one of the main thrusts of NINCDS research efforts. However, areas of neurotoxicology, such as drug-induced adverse reactions, use of toxic chemicals in understanding physiological mechanisms of the nervous system, localization and disposition of substances involved in neurotoxicity and some other related aspects of neurotoxicology, are of prime interest to the NINCDS.

Studies are being supported on the neurotoxic effects of heavy metals and artificial food colors. The objective of some of these studies is to develop appropriate animal models that will provide information on the basic mechanisms of neurological diseases and their potential therapy. Some research is devoted to synthesis of neurologically active agents, characterization of biologically active peptides in venoms, mode of action of neurotoxicants, analysis of the effects of neurotoxic chemicals on the nervous sytem, pathogenesis of peripheral neuropathies and modulation of the toxicity by endogenous substances. Some of the studies focus on the localization and disposition of neuroactive elements. Studies are also supported at electron microscopic and cellular levels using high resolution techniques to develop sensitive cytochemical and histochemical information.

A number of other studies are focused toward elucidating the underlying mechanisms of toxicity induced by suspected toxic or neurologically teratogenic substances.

National Library of Medicine

Although the National Library of Medicine (NLM) does not conduct or support research and development, it contributes significantly to the environmental health research and development activities in the Department through its Toxicology Information Program (TIP). TIP's objectives are: to create computer-based toxicology data banks from the scientific literature and from the files of collaborating industrial, academic, and governmental organizations; and to establish toxicology information services for the scientific community.

The following were generated to meet these objectives:

CHEMLINE is an online, interactive chemical dictionary file which provides a mechanism whereby over 1,000,000 substance names representing some 540,000 unique substances for which records available in TOXLINE and other NLM databases can be searched and basic information retrieved.

TOXLINE is an extensive collection of computerized toxicology information which offers online interactive access to more than 465,000 references from 1979-present to published human and animal toxicity studies, effects of environmental chemicals and pollutants, adverse drug reactions, and analytical methodology.

Registry of Toxic Effects of Chemical Substances (RTECS) is an online version of the National Institute for Occupational Safety and Health publication of the same name. RTECS provides the online user with toxicity data on over 55,000 substances. In many instances, the file also provides information on threshold limit values, recommended standards in air, aquatic toxicity, and eye and skin irritation.

Toxicology Data Bank (TDB) is an online, interactive data retrieval service which contains evaluated data describing the chemical and biological properties and the usage of selected chemical substances which are hazardous and to which populations may be either deliberately or inadvertently exposed.

The Toxicology Information Response Center (TIRC) was established by the Oak Ridge National Laboratory under NLM sponsorship some 10 years ago. Its role is to provide literature services in chemical toxicology on a cost-recovery basis in response to requests.

TOX-TIPS (Toxicology Testing-in-Progress) is a monthly current awareness bulletin containing reports of ongoing or planned toxicity testing of chemicals. The publication results from the cooperative efforts of industrial, governmental, and academic organizations. The objective of this prompt dissemination of project descriptions is to avoid unnecessary duplication of expensive programs; hence, priority is given to reporting long-term studies.

The Information Response to Chemical Concerns (IRCC), working through TIRC, provides to participating agencies, upon demand, express literature searches. It also prepares comprehensive bibliographies on key topics, which are distributed to the public by the Federation of American Societies for Experimental Biology.

Division of Research Resources

The Division of Research Resources (DRR) provides or improves a research institutional environment or a research resource by supporting the necessary personnel, tools, and/or materials to facilitate the effective conduct of biomedical research. DRR's environmental health related research is as follows:

The Animal Resources Program's research characterizes healthy animal development which can be related to mutagenic, carcinogenic or teratogenic effects of exposure to toxic chemicals whether through the environment or the adverse effects of drugs. These animals are particularly useful in determining chromosomal aberrations, infertility and behavioral effects due to toxic chemicals.

High voltage electron microscopes, mass spectrometers, nuclear magnetic resonances, and other innovative technologies are supported by the Biotechnology Resource Program. These technologies have a unique impact in the area of toxicology research because structural and conformational studies can be rapidly done using chemical mutagens and carcinogens.

Animal studies are designed to determine the toxic effects of chemicals on target organs and body systems and to characterize their carcinogenic, mutagenic and teratogenic potential. Behavioral anomalies in neonatal primates which result from previous exposure are being investigated. Studies of the structure of toxic chemicals result in more differentiated screening techniques. Lasers are being used to detect carcinogenesis. Analyses of body fluids for trace metals and other chemicals are being researched as possible detection screens.

Scientists are trying to develop new or better plant/animal model systems for extrapolation of research to humans. Techniques are being developed for separating and measuring toxic biological samples. *In vivo* and *in vitro* assays are being developed to detect selected toxic chemicals and determine the mode of action which results in disease and/or adversely affects human status. Statistical models are being developed for air pollutants.

DHHS COMMITTEE TO COORDINATE ENVIRONMENTAL AND RELATED PROGRAMS

The DHHS Committee to Coordinate Environmental and Related Programs (CCERP) was established by the Assistant Secretary for Health, DHHS, as a multiagency group to provide a medium to assure the exchange of information on environmental health, toxicology and related programs, to coordinate these programs, to enhance the sharing of resources and to provide advice to the Department. The Committee interacts with other components of the Federal Government in areas of mutual interest and concern.

The Coordinating Committee provides advice to the Department to aid in determining the allocation of resources among goals and activities and provides advice on critical problems in environmental health, toxicology and related programs to the Assistant Secretary for Health. It serves as the focus for DHHS to receive and to provide information and advice on relevant environmental health, toxicology and related programs and/or problems of concern to the scientific and industrial communities and other Federal agencies, and state and local governments.

The Department members of the Committee are:

Office of the Assistant Secretary of Health

Director, National Institutes of Health

Director, National Institute of General Medical Sciences

Director, National Cancer Institute

Director, National Institute of Environmental Health Sciences

Director, National Library of Medicine

Director, National Institute on Aging

Director, National Institute of Child Health and Human Development

Director, National Heart, Lung and Blood Institute

Director, National Institute of Neurological and Communicative Disorders and Stroke

Director, National Institute of Dental Research

Director, National Eye Institute

Director, National Institute of Allergy and Infectious Diseases

Director, National Institute of Arthritis, Metabolism and Digestive and Kidney Diseases

Director, Alcohol, Drug Abuse and Mental Health Administration

Director, National Institute of Mental Health

Director, Centers for Disease Control (CDC)

Director, CDC/National Institute for Occupational Safety and Health

Director, CDC/Center for Environmental Health

Commissioner, Food and Drug Administration (FDA)

Director, FDA/National Center for Toxicological Research

The Committee includes liaison representation from:

Consumer Product Safety Commission

Environmental Protection Agency

Occupational Safety and Health Administration

Council on Environmental Quality

Library of Congress

Department of Energy

National Oceanographic and Atmospheric Administration

Department of the Navy

U.S. Army Environmental Hygiene Agency

Wright Patterson Air Force Base

National Science Foundation

The Committee's Executive Committee whose membership is entirely within the Department, serves as the Department's primary environmental health policy formulation and monitoring entity for implementation and for making recommendations to the Secretary through the Assistant Secretary for Health.

The Committee has a number of standing and ad hoc subcommittees that deal with scientific aspects of particular environmental health and toxicological problems. Membership on these subcommittees includes Department and other Federal agencies representatives.

NATIONAL TOXICOLOGY PROGRAM

The National Toxicology Program (NTP) begins its sixth year of operation in FY 1984. The NTP was established in November 1978 as a Department of Health and Human Services cooperative effort to coordinate and provide information about potentially toxic chemicals to regulatory and research agencies and to strengthen the science base in toxicology. Because the Public Health Service of DHHS is responsible for safeguarding the public's health, prevention of human exposure to toxic substances is integral to disease prevention. Thus, the establishment of the NTP was a logical outgrowth from the need for better coordination and program integration of the DHHS toxicology research and testing activities.

The Program has evolved into a major Federal resource for testing of chemicals and represents the leading effort in the world aimed at developing better, faster and less expensive methods for determining whether chemicals may be hazardous. There are also significant toxicology research, testing, and test methods development activities ongoing in other Federal agencies. Current information on many of these efforts may be found in the FY 1983 Review of Current DHHS, DOE, and EPA Research Related to Toxicology.

Currently, the NTP consists of the relevant toxicology activities of the National Institutes of Health's National Institute of Environmental Health Sciences (NIH/NIEHS); the Food and Drug Administration's National Center for Toxicological Research (FDA/NCTR); and the Centers for Disease Control's National Institute for Occupational Safety and Health (CDC/NIOSH). Resources for the program originate from the budgets of these agencies. The NTP activities to which these agencies allocate their resources are planned and accomplished as a coordinated effort under the leadership of the Program Director, Dr. David P. Rall, who also is Director of the NIEHS. For purposes of the NTP, he reports to Dr. Edward N. Brandt, Jr., Assistant Secretary for Health, DHHS.

The National Institutes of Health's National Cancer Institute (NIH/NCI) was a charter agency. The NCI carcinogenesis bioassay program, including personnel and other resources, was transferred to the NIEHS in July 1981. The NCI remains active in the Program through membership on the Executive Committee.

Within the framework of its charge to identify those chemicals potentially toxic to humans, the broad goal of the NTP is to coordinate and strengthen the activities of the Department of Health and Human Services in testing chemicals of public health concern, as well as to develop and validate new and better integrated test methods. Four specific goals are:

- Expand the spectrum of toxicologic information obtained on the chemicals nominated, selected, and being tested.
- Increase the numbers of chemicals tested in various short-term assays, within the funding limits.
- Develop, coordinate, and validate a series of tests and protocols more appropriate for regulatory needs.
- Communicate Program plans and results to governmental agencies, the medical and scientific communities, and the public.

STATEMENT OF DALLAS L. PECK
DIRECTOR, U.S. GEOLOGICAL SURVEY
DEPARTMENT OF THE INTERIOR
BEFORE THE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIROMENTAL OVERSIGHT
UNITED STATES SENATE

October 17, 1983

Mr. Chairman, I am Dallas Peck, Director of the U.S. Geological Survey, representing the Department of the Interior as Science Advisor to the Secretary. I have with me this morning Richard Smith, Associate Director, Research and Development, Fish and Wildlife Service, and Philip Cohen, Chief Hydrologist, U.S. Geological Survey.

We are here at your invitation to discuss environmental research and development activities of the Department of the Interior. Environmental research and development is a significant part of the programs of the Department.

Much of our major environment-oriented activity involves issues important to the Nation's future well-being, such as toxic substances in the environment, hazardous waste disposal, and nuclear waste disposal. Those activities cross bureau lines within the Department and involve other agencies as well, in particular the Evnironmental Protection Agency, the National Oceanic and Atmospheric Administration, the Department of Energy, and the Nuclear Regulatory Commission.

The environmental issue that involves more of the Department than any other is toxic subtances in the environment. At the Department of the Interior, we have people who are active in the following kinds of environmental research and development activities related to toxic substances:

- Definition of the occurrence, distribution, and fate of trace metals and trace organic substances in surface metals and ground water.
- The effects of pollutants on fish and wildlife populations.
- Collection of earth-science information needed by resource managers to mitigate the effects of waste disposal storage and spills on ground-water systems.
- Analyses of trends in the acidity of the Nation's water resources in relation to the acidity of precipitation.
- Evaluation of the effects of air pollution on the resources of our national park system and identify reaction of remedial actions.
- The effects of coal development on water resources.
- Evaluation of the environmental impact associated with the development of leases on the Outer Continental Shelf.
- Assistance to the Department of Energy in selection of candidate sites for disposal of high-level nuclear waste, as required by the Nuclear Waste Policy Act of 1982.

Many of these programs are cooperative efforts involving many organizations. Acid precipitation studies, as an example, not only involve the bureaus of the Interior Department, but also the Environmental Protection Agency, the Department of Agriculture, the National Oceanic and Atmospheric Administration, the Tennessee Valley Authority, and the National Aeronautics and Space Administration.

In studying acid rain, we have found that trends in sulfate and alkalinity concentrations in streams across the Nation correlate with reported regional emissions of sulfur dioxide. In the northeast, sulfur emmissions have decreased and stream data are consistent with slightly decreased concentrations of sulfuric acid in precipitation and a resulting slight recovery of stream buffering capacity. In other regions of the country, sulfur emissions have increased and stream data are consistent with slightly increased concentrations of sulfuric acid and precipitation and resulting a decrease in stream buffering capacity.

For the last several years, the National Park Service has conducted an Air Quality Program. The research objectives of the program are to: assess air quality in the parks and the condition of park resources sensitive to air pollution; to assess the significance of air pollution on park resources and visitor experience; and to identify both the causes of existing air quality effects and the remedial actions to mitigate the effects.

The goals of the research are to determine the relative sensitivities of park vegetation to specific air pollutants; to determine loadings of trace elements and pollutant levels in air soils and vegetation; and to determine whether air pollution effects are impairing the structure and functioning of the park ecosystems. In addition, research is conducted to determine air pollution concentrations in park areas lacking air quality monitoring data, and to identify the source regions of emissions which contribute to existing air pollution.

The Fish and Wildlife Service, among other important environmental research activities, conducts research on contaminants and their effects on the Nation's fish and wildlife source. The program objectives are to: conduct applied research studies to identify and provide scientific information on fish and wildlife populations and ecosystems of high Federal interest and concern that are adversely affected by contaminants; to recommend corrective measures and/or management alternatives to reduce the exposure of fish and wildlife to environmental contaminants; to develop, maintain, and transfer ecological information to Federal, State, and private users to address fish and wildlife habitat and resource issues of national and regional importance, and to minimize and mitigate the effects of development on those resources; and to provide technical assistance and training to resource managers and other decisionmakers who use ecological information and tools to effectively manage fish and wildlife resources and their habitats.

Some of the recent research outputs from the program are:

o Identification of some acute and sub-lethal impacts of agricultural chemicals, heavy metals, and other hazardous materials to fish and wildlife. For example, the correlation between bent backbones and chemical stress was developed by the Fish and Wildlife Service.

- Identification of the impact of oil pollution on fish, waterfowl, sea turtles, and other vertebrates has been important in assessing the effects of oil spills.

- Investigation of the pathways by which contaminants affect fish and wildlife species, i.e., the routes of bioaccumulation.

- Service research has been instrumental in the documentation of impacts of acid rain on the fish population of lakes in the northeast central States.

- A National Wetland Classification and the National Wetland Inventory Methodology have been developed and transferred to operational units of the Service.

- The habitat evaluation procedures have been developed and have been adopted by the Fish and Wildlife Service, Corps of Engineers, and Soil Conservation Service.

- A variety of maps, including the Ecological Inventory Series, which displays national resource information for the Atlantic, Pacific, and Gulf coastal areas, are now being sold by the U.S. Geological Survey. Other maps include computerized maps and analytical tools for coastal areas: resources impacted by the Outer Continental Shelf oil and gas development: resources affected by Federal coal lease; and maps of wetland change in many parts of the United States. These maps are being used by a variety of State and Federal agencies.

- A review series on the effects of acid precipitation, including a handbook of liming as a potential tool to mitigate the impacts of acid precipitation was produced.

- The atlas to identify developed and underdeveloped barrier islands under Coastal Barrier Resource Act was developed.

This administration has made a major effort to make more of the Outer Continental Shelf available for leasing for oil and gas. One of the associated concerns is that lease development occurs in an environmentally sensitive manner. To achieve this end, the Department requires detailed environmental impact statements for areas covered by lease offerings. To date, the Department has spent over $335 million on environmental and socioeconomic studies. These have covered every stage of the offshore leasing, drilling, and production on such topics as marine mammals, shellfish, oil spill risks, air quality, social and economic impacts, and changes in biological communities around drilling rigs. As part of the prelease process, we develop special stipulations and other mitigating measures to respond to concerns unique to each lease offering. In addition, site-specific stipulations are attached to each lease to add further protection for important biological resources, and the most modern environmental safety technology is required at each stage of development. Finally, each Outer Continental Shelf facility is inspected for environmental protection.

I have briefly given you an overview of the range of environmental research and development activities in the Department of the Interior. In order to inform the Subcommitte more fully of these and additional Department of the

Interior bureau programs, I am providing for the record a brief discussion of the activities within a number of the bureaus of the Department. I am also prepared to provide the Subcommittee a representative sampling of reports and papers published by organizations in the Department.

Attached to this statement is a summary of the funding in the Department for environmental research and development over the last 5 years and for fiscal year 1984.

We would be happy to respond to any questions you may have.

MINERALS MANAGEMENT SERVICE

The Minerals Management Service, which is responsible for offshore leasing and collection of royalties from Federal leases, has a significant responsibility in environmental matters. The protection of the offshore environment is of particular concern to all of us. Because of that concern and the efforts of the Government to respond to it, the record of protection of the offshore environment has been extremely good.

The Outer Continental Shelf leasing process includes the preparation of detailed environmental impact statements for areas covered by lease offerings, to complement the large array of ecological and socioeconomic data the Interior Department has developed over the years on virtually every aspect of offshore operations. To date, Interior has spent over $335 million on environmental and socioeconomic studies, covering every stage of the offshore leasing, drilling, and production process on such topics as marine mammals, shellfish, oil spill risks, air quality, social and economic impacts and changes in biological communities around drilling rigs. The Department continues to conduct more analyses at the rate of about $30 million a year.

The Minerals Management Service has done recent studies of the possible effects of drilling muds and well cuttings showing that the bottom sediments stirred up annually by New England's sea scallop harvesting industry alone are equivalent to the muds and cuttings from over 100,000 exploratory wells of 10,000 feet of depth, and that these similar fishing operations themselves have had no noticeable detrimental effects on marine life. Studies have also shown that the small amount of metallic compounds used in drilling muds are quickly dispersed and produce no detectable impacts to marine life under normal offshore conditions.

The Minerals Management Service, under its Technology Assessment and Research Program, monitors and analyzes seafloor seismic data. Planned research for fiscal year 1984 will consider the structural response and residual strength of offshore structures when subject to earthquakes. Another project will consider the effects of ocean-bottom movement on subsea pipelines. Recent projects include modelling of offshore risks and the study of soil-structure interaction, structure and pipeline fracture and fatigue, oil spill containment and collection, structural inspection methods, and well control procedures.

Many Minerals Management Service environment-related activities are carried on jointly with other agencies, including the U.S. Geological Survey and the Fish and Wildlife Service, as well as industry.

BUREAU OF LAND MANAGEMENT

The Bureau of Land Management, which has the responsibility for managing a large percentage of the Federal lands, conducts environmental research and development directly related to the priorities of the Bureau's operating program. Before research and development is initiated, it must be shown that the results are to contribute to the decision process for management of public land resources within the administrative responsibility of the Bureau.

Over the period 1979-1984, these priorities have shifted in importance between: coal development and its potential impacts on water resources; wildlife habitat impacts related to land use decisions; wildfire detection and control: wild horses and burros: watershed protection with respect to soil erosion and water quality; the importance of grazing management systems on the vegetation resources that are directly related to multiple uses such as recreation, wildlife habitat, and protection of the natural productivity of the soil; and reforestation of timbered areas.

Research is normally an activity that is contracted through cooperative agreements, interagency agreements or other vehicles. The percent of the Bureau of Land Management's funded research completed by other Federal agencies will vary between 65 percent and 75 percent. The U.S. Geological Survey, U.S. Forest Service, and Agricultural Research Service are the three main action agencies, followed by the Fish and Wildlife Service and the Environmental Protection Agency. On the average, one-third of the research and development funds are devoted to research.

Development, meaning the translation of applied research into formats having utility to Bureau personnel, is mainly the responsibility of the Bureau. Approximately 75 percent of the development effort is conducted in-house by the employees familiar with research results and their application to challenges facing the Bureau.

All major research projects have periodic reports which are distributed internally and to the Department library. The major development reports are only distributed to internal offices known to have the opportunity for application. Where appropriate, manuals are updated to incorporate advances in the state-of-art.

There is an internal tracking system available to all offices that provides a status report of all research and development in progress within the Bureau. This system permits anyone to make inquiries of the responsible parties concerning possible application of their particular projects.

The recent funding levels for the Buerau of Land Management environmental research and development are as follows:

Fiscal Year 1979	$6,800,000
Fiscal Year 1980	$7,300,000
Fiscal Year 1981	$7,600,000
Fiscal Year 1982	$7,600,000
Fiscal Year 1983	$8,900,000
Fiscal Year 1984	$6,400,000

NATIONAL PARK SERVICE

The National Park Service has two major environment-oriented research programs, one in air quality and the other in acid rain.

I. The Air Quality Program was initiated in 1978. Research activites are limited to efforts designed to provide effective tools, methods, and data needed by decisionmakers to recognize and respond to air quality effects within the National Park System.

The objectives of the National Park Service air quality research are:

1. To assess the condition of air quality and park resources sensitive to air pollution.

2. To assess the significance of air pollution on park resources and visitor experience.

3. To identify the causes of existing air quality effects and to identify remedial actions to mitigate effects.

Priorities for achieving the stated objectives include three areas of research:

1. Air Quality Related Values Sensitivity and Effects - Determines relative sensitivities of park vegetative resources to specific air pollutants, determines loadings of trace elements and pollutant levels in park vegetation and soils, and determines whether air pollution effects are impairing the structure and functioning of the park ecosystem.

2. Visibility Research - Determines the pollutants responsible for visibility impairment in certain parks, the anthropogenic and natural sources of air pollutants responsible for impairment, and the relationship between visibility conditions and meteorological and climatological conditions, and the relationship of the physical optical characteristics of impairment of human perception and visitor enjoyment.

3. Meteorological/Atmospheric Transport and Diffusion Research - Determines existing air pollution concentrations in park areas lacking air quality monitoring data, and identifies air pollution emission source regions which contribute to existing air pollution background concentrations in National Parks.

Air quality related values research involves cooperative research efforts with the U.S. Forest Service, Environmental Protection Agency/Corvallie, Department of Energy/Oak Ridge National Laboratory, and the U.S. Geological Survey. Visibility research is conducted cooperatively with the National Oceanic and Atmospheric Administration, Environmental Protection Agency, Bureau of Land

Management, Department of Defense, and the Electric Power Research Institute. Meteorological/atmospheric research is conducted cooperatively with the National Oceanic and Atmospheric Administration. Cooperative efforts are designed to eliminate duplication and to maximize the best use of limited resources through cost sharing.

The National Park Service Air Quality Program is the primary user of the information. The information is used in making "adverse impact" determinations as part of the Federal land manager's affirmative responsibility under the prevention of significant deterioration new source review provisions of the Clean Air Act. Findings of research projects are disseminated through symposiums, National Park Service hosted workshops and scheduled training sessions, and are published as articles in scientific and air pollution journals. National Park Service scientists have published technical articles in journals such as Atmospheric Environment, Journal of Environmental Quality, The Journal of the Air Pollution Control Association, Environmental and Experimental Botany, Journal of Applied Ecology, Journal of the Optical Society of America, and Journal of Applied Meteorology.

II. Acid rain research has grown from a small beginning in 1979, funded at $50,000, to a fiscal year 1984 level of $597,000. National Park Service acid rain research priorities are to establish 9 or 10 long-term park acidification study sites, and to provide for the continued operationof 23 atmospheric national trend monitoring sites within System areas. National Park Service research objectives are:

(1) determination of chemical composition in selected parks with correlation to its region and the Nation; (2) develop record of acid precipitation inputs; (3) detect chemical changes within each ecosystem; (4) detect biological changes in each ecosystem; (5) establish nationally representative baseline sites; (6) partition the cause and effect relationship of long-term changes; (7) evaluate how different unmanipulated sites respond to acidification; (8) establish early warning system to measure ecosystem response; and (9) develop sound technical basis for decisionmaking on land and water management practices and to remedy adverse impacts of acid deposition.

The focus and direction of the National Park Service acid precipitation studies is determined by the Federal Interagency Task Force on Acid Precipitation, which includes representatives of 12 Federal agencies. The National Park Service priorities have been established through this 12 agency cooperative effort. The National Park Service and the Department of the Interior are represented on the Task Force's Research Coordination Council. The National Park Service is cooperating at the sites it maintains with a number of universities and Federal agencies including the U.S. Geological Survey, Environmental Protection Agency, Department of Agriculture, National Oceanic and Atmospheric Administration, Tennessee Valley Authority, and National Aeronautics and Space Administration. The National Park Service research does not duplicate other Federal agency research efforts because of the Service's participation on the Interagency Task Force, which includes coordinated planning and peer review for the development of research activities.

The National Park Service data is entered into national data banks operated and maintained principally by the U.S. Geological Survey, Environmental Protection Agency, and Department of Energy's national laboratories. Information is also disseminated through reports of the Task Force, publications in scientific literature, and through periodically issued technical reports. The National Park Service technical reports are distributed to park managers to assist them in assessing problems related to acidification. Information and assistance is also provided by the National Park Service staff to park managers in assessing potential problems related to acidification. Information is also disseminated at scheduled training sessions.

Funding levels for the National Park Service's programs for the last several years is as follows:

Air Quality Program

Fiscal Year 1979	$100,000
Fiscal Year 1980	$300,000
Fiscal Year 1981	$300,000
Fiscal Year 1982	$600,000
Fiscal Year 1983	$800,000
Fiscal Year 1984	$800,000

Acid Rain Research

Fiscal Year 1979	$ 50,000
Fiscal Year 1980	$125,000
Fiscal Year 1981	$125,000
Fiscal Year 1982	$424,600
Fiscal Year 1983	$575,000
Fiscal Year 1984	$597,000

FISH AND WILDLIFE SERVICE

The research and development in the Fish and Wildlife Service is applied to issues and interests identified by the agency. The research program addresses information needs related to wildlife including migratory birds, some nonmigratory birds and mammals, and also related to fisheries and to endangered species. The program also gathers information on the effects of land development and contaminants on fish and wildlife. The development portion of the effort involves transfer of technical information to a wide variety of user groups.

Wildlife research provides the Service with basic biological information about species numbers, population dynamics, ecological relationships, and habitat requirements. This information allows for the establishment of prudent hunting regulations, description of critical habitats, identification of populations in danger of becoming "threatened", development of optimum land use management programs, reduction of nonhunting mortality, assessment of environmental impacts, adequate mitigation of habitat losses, and increased opportunities to utilize and enjoy the resources.

I. Fishery Research

The objectives of the Service's fishery research is:

- To provide information, methodology, and materials to assist fishery managers in decisions about protection, enhancement, and utilization of the Nation's fishery resources.

- To collect, collate, and interpret diverse information on fish species, populations, and habitats to address specific needs of the Service.
- As feasible, to respond to the needs of other Federal agencies, Indian tribes, State agencies, international groups, and private organizations involved in fish culture.

II. Endangered Species Research

Research is also conducted to develop the tools and techniques to more effectively manage species listed on the United States List of Threatened and Endangered Wildlife. These research investigations may be:

- In-depth studies of individual species or groups of species within a given ecosystem.
- Habitat evaluations.
- Indentification of limiting factors.
- Other actions identified in recovery plans as essential to species recovery.

III. Contaminant Research

The Service's contaminant research focuses on fish and wildlife resources of high national interest or concern. The following are some of the study areas:

- Impact on fish and wildlife populations of pollutants associated with land use practices and riverine modifications.
- Aquatic and terrestrial resource investigations of acid precipitation and associated metals.
- Ecological/resource assessments of agriculture chemicals used in forest, range, and crop management on fish and wildlife.
- Fish and wildlife investigations on contaminants in the Great Lakes ecosystem.
- Waterfowl production in the wetlands impacted by contaminants.
- Biological and physiological indicators of contaminant-induced stress in aquatic and terrestrial populations.

IV. Joint Research with Other Agencies

The Fish and Wildlife Service has a number of joint research efforts underway with other Federal agencies, both within and outside the Department of the Interior.

Some examples of this research are studies designed to learn the effects of Federal construction projects on fish resources with the Bureau of Reclamation, acid rain and toxaphene studies with the

Environmental Protection Agency, and studies designed to learn the effects of forest practices on fish and wildlife resources with the Forest Service.

V. Dissemination of Research Results

All the research that is undertaken meets the needs of the Fish and Wildlife Service, but by its nature a large portion of the information generated is useful to other organizations that manage fish and wildlife resources. Other Federal agencies, international, State, and local governments as well as the private sector all utilize research information generated by the Service. Information gathered from these studies is synthesized into a variety of formats, such as technical summaries, executive briefings, workshops and seminars, that more directly address the needs of each user group. Approximately 35 percent of the information is used directly in regulatory processes to assist in areas such as wetland determinations or effects of various chemicals on fish and wildlife. At least 20 percent issued by the private sector. Topics related to fish culture are of interest to the fishing industry, effects of development on fish and wildlife habitats to environmental consultants and engineers, and wildlife feeding patterns to the forestry and agriculture industries.

VI. Recent Research Appropriations

Fiscal Year 1980	$36,400,000
Fiscal Year 1981	$38,400,000
Fiscal Year 1982	$41,000,000
Fiscal Year 1983	$39,700,000
Fiscal Year 1984	$35,500,000

BUREAU OF RECLAMATION

The Bureau of Reclamation is involved in environmental research and development through a number of projects related to water quality. Such research is focused on finding new and better ways to protect the quality of water resources so that available supplies are not rendered unfit for use and so that environmental and ecological balances are not adversely upset. Studies encompass research on control of water quality by such methods as reaeration of reservoir and river water, better management of impoundments and streams, determination of potential effects of residues of selected herbicides used for weed control, and identification of other sources of pollution. Separate from research activities, ecological studies are performed for specific projects and purposes to determine effects of projects and water management on overall environment and ecology of the area, provide data to design projects for minimum impact, and develop general limnology data and planning tools for predicting future impact.

Some of the research projects include aquatic limnology which is done in cooperation with appropriate State and Federal agencies. Staffs work jointly, data are shared, and reports prepared jointly and/or in cooperation. Some examples are:

o Biological effects of reservoir reaeration in California. Cooperators are the Cacitas Municipal Water District and the Santa Inez Water District.

- Limnology of North Platte Reservoirs. Cooperators are the Wyoming Fish and Game Department and the U.S. Fish and Wildlife Service.

- Ecology of pumped storage powerplant reservoirs. Cooperators are the Colorado State University, U.S. Fish and Wildlife Service, and the Colorado Division of Wildlife.

- Columbia Basin Aquatic and Wildlife Study. Cooperators are the U.S. Fish and Wildlife Service and the Washington Department of Game.

- Ecological modeling of reservoirs. Cooperators are the Corps of Engineers and the Tennessee Valley Authority.

Another area of research concerns aquatic weed control, which is coordinated and in cooperation with Federal, State, and private companies, as appropriate. Some examples are:

- Collection of efficacy and residue data for registration of aquatic herbicides for use on water resource development projects. In general, U.S Department of Agriculture and U.S. Fish and Wildlife Service have been and are cooperators. A specific recent example is Studies for Use of 24D for Control of Eurasian Water Millfoil in Western Reservoirs. Other cooperators are Corps of Engineers and Fort Cobb Conservancy District, and Union Carbide.

- Development of controlled released herbicides. The cooperator is the Corps of Engineers.

- Control of hydrilla in California water systems. Cooperators are the Coachella Valley Water District, Imperial Irrigation District, U.S. Department of Agriculture, U.S. Fish and Wildlife Service, California Department of Agriculture, and the California Fish and Game Department.

- Use of herbivorous fish in cooler water systems. Cooperators are the U.S. Fish and Wildlife Service, Northern Colorado Water Conservancy District, and Boulder Ditch Company.

Reservoir limnological and aquatic weed control type of ecological and environmental research is coordinated with the Tennessee Valley Authority and the Corps of Engineers through the Bureau of Reclamation, Tennessee Valley Authority, Corps of Engineers, and Bonneville Power Administration Interagency Research Coordination Conferences held every 2 years and by 3 working groups established under this program. These working groups cover reservoir reareation, reservoir ecology and modeling, and aquatic pesticide management. Cooperative projects are promoted through the working groups.

The Bureau participated in a project during fiscal year 1976 through 1980 which resulted in a 1981 report entitled the National Reservoir Inundation Study. This report stems from an initial cooperative effort of the Corps of Engineers, Bureau of Reclamation, Soil Conservation Service, and the National Park Service to find practical and demonstrable solutions at the field level to commonly shared problems faced by field managers in the conservation management of inundated cultural resources. The National Reservoir Inundation Study began in early 1976 and research operations ended in September 1980.

Reclamation's funding level:

Fiscal Year 1976	$37,000 (including transition quarter)
Fiscal Year 1977	$50,000
Fiscal Year 1978	$50,000
Fiscal Year 1979	$40,000
Fiscal Year 1980	$75,000

The total project cost was somewhat over $1 million.

In addition to the general research program, the Bureau is involved in Project Skywater. This is a program of research and development in the management of precipitation through weather modification. The purpose of Project Skywater is to develop a technology of precipitation management that is scientifically sound, effective, and socially acceptable, and to assist in the transfer of this technology to users. Included are cooperative and interagency work with the U.S. Forest Service, the State of Colorado, and the University of Nevada in order to investigate and monitor environmental response to precipitation, to help develop Colorado State policies for weather modification programs, to develop a cloud seeding management plan for Colorado, and to determine the effect of climate, snowfall, and avalances on human activity, among other tasks.

The Bureau ensures that the results of research in appropriately disseminated to users through the following mechanisms:

o Agency reports. Bureau work is fully documented in REC/ERC Service reports, occasional special reports, newsletters such as "Research Now," and contractor reports.

- Technical presentations and papers for established professional societies. Significant findings are disseminated through the appropriate societies.

- Special workshops and briefings. A wide range of workshops, briefing sessions, and seminars are used to disseminate research findings. Some are for Reclamation staff in particular need, others are for Reclamation project operations, and many are national or international specialty workshops or seminars.

- Direct personal. An important and frequently used method is through direct personal contact between user and research workers. Often the user is part of a cooperative effort and has ongoing personal knowledge of the work and can influence the research goals and directions.

The Bureau of Reclamation's budget for environmental research and developemnt activities for the last several years is as follows:

- Program Related Environmental Research

Fiscal Year 1979	$421,000
Fiscal Year 1980	$471,000
Fiscal Year 1981	$460,000
Fiscal Year 1982	$477,000
Fiscal Year 1983	$505,000
Fiscal Year 1984	$550,000

- Weather Modification Research

Fiscal Year 1979	$ 53,000
Fiscal Year 1980	$ 54,000
Fiscal Year 1981	$ 83,000
Fiscal Year 1982	$150,000
Fiscal Year 1983	$107,000
Fiscal Year 1984	$ 70,000

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT

Environmental Research/Special Studies

The Office of Surface Mining engages in research work which will result in improved methods of land reclamation or decreased adverse environmental effects during or resulting from the surface or underground mining of coal.

Priorities for research project areas vary from year to year depending upon factors such as the amount of funds available, the type of research investigations ongoing by other cooperating agencies, and the types and severity of current problems. Currently, emphasis is being placed on subsidence, hydrology, coal waste, and revegetation with these kinds of projects receiving priority in the allocation of funds for fiscal year 1984.

Whenever possible in order to prevent duplication of research efforts and to obtain more dollar value, the Office of Surface Mining combines projects with other Federal agencies. Examples of these cooperative venture are the effectiveness of the Office of Surface Mining regulations in preventing ground-water contamination with the Environmental Protection Agency, ground-water studies in Georgia with the Tennessee Valley Authority, cumulative hydrologic impact information with the U.S. Geological Survey, and a plant materials study to identify plant associations suited to coal mine reclamation with the U.S. Department of Agriculture. In addition, the Office of Surface Mining also has cooperative studies with States, universities, and coal mining companies.

Upon completion of the project, copies are disseminated to interested parties from the Washington Headquarters of the Office of Surface Mining, the Office of Surface Mining technical centers, and field offices. An abstract of the study wil be placed on a computer bibliography retrieval system, however copies are available upon request at Headquarters. Reference is made to the projects whenever they are used in regulations or technical manuals. They are also briefly described in the Office of Surface Mining annual report.

U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey is responsible for or deeply involved in a number of environment-oriented research and development programs. The topics for research and development programs include the following:

o Toxic Substances in Surface Waters

The U.S. Geological Survey provides hydrologic information and understanding needed by other agencies to develop, manage, and regulate the Nation's water resources. In this context, the U.S. Geological Survey recently began a new program on toxic waste/ground-water contamination and has added increased emphasis to the ongoing study of toxic substances in surface waters.

In 1973, the Geological Survey began the National Stream Quality Accounting Network (NASQAN), which with 504 operating stations, provides a basis for continuously assessing the quality of major United States rivers with respect to both natural and man-induced factors. Stations are located to measure outflow from 331 accounting units (subregional drainage basins) which, collectively, encompass nearly the entire land surface of the Nation. Data collected in the NASQAN include streamflow, concentrations of major inorganic and trace constituents (including toxic metals), bacterial indicators of pollution, and concentrations of a limited number of radiochemical constituents.

A major purpose of the network is to detect trends over time in the concentrations of significant constituents of water quality. It is important to note, however, that the data from these networks alone cannot determine why water quality is changing. Such conclusions can only be developed through correlation of the network data with other information.

Since 1979, the growing concern of State agencies over contamination of surface- and ground-water resources has brought about a reorientation of the water-quality efforts in the Geological Survey's Federal/State Cooperative Program toward studies of the occurrence, distribution, and fate of toxic substances. This reorientation has been reflected in both the number and the complexity of projects concerned with toxic substances in virtally all Geological Survey offices. Internally, Geological Survey has reoriented research support and laboratory services to meet the growing needs of the Federal/State Cooperative Program. Significant advances have been made in achieving lower limits of quantification for many substances of concern and in detecting low levels of organic contaminants rapidly and inexpensively.

An example of the work that Geological Survey has conducted on toxic substances in rivers is the investigation of polychlorinated biphenyls (PCB) which were discharged to the Hudson River between 1947-1977. The Survey has found that, since 1977, the mean annual concentrations and PCB transport rates in the Hudson River have decreased about 75 percent. We have also found that scouring of sediments is now the primary transport mechanism. During spring runoff in 1983, transport rates were about 100 pounds per day; during low flows, when sediment scour was minimal, the rate was about 2.5 pounds per day.

Whereas the number of toxic-waste investigative studies has increased in recent years, expenditures have decreased for fixed-station monitoring of trace substances in surface waters. The decrease is temporary and stems primarily from our need to assess whether the fixed-station approach used to monitor major constituents in surface waters is truly applicable to trace substances. We have concluded that the fixed-station approach is only partly applicable, and a new program consisting of several new approaches is nearly ready to begin.

o Toxic Substances in Ground Waters

In the late 1970's, results from ongoing programs indicated that additional basic research and applied studies were needed to better understand the effect of land use and waste disposal on ground-water quality. In fiscal year 1982, the Geological Survey created the Toxic Waste/Ground-Water Contamination Program to address these issues.

The objective of this program is to provide the earth-science information needed by resource managers to mitigate the effects of waste disposal, storage, and spills on ground-water systems, and to improve future waste-disposal practices. To fulfill this purpose, the Geological Survey is:

o Conducting intensive research into the physical, chemical, and biological principles governing ground-water contamination; much of this research is focused at selected disposal sites where laboratory and analytical findings can be applied and evaluated in the field.

- Conducting regional and national appraisals of ground-water quality.

- Assisting Federal and State agencies in the development of guidelines and standards for managing the disposal of hazardous wastes.

This year, we began new research studies at three field sites having a documented history of ground-water contamination dating back a few years to several decades. These sites include an oil spill near Bemidji, Minnesota; chemical contamination from a wood treatment plant near Pensacola, Florida; and contamination of ground water by sewage on Cape Cod, Massachusetts. These studies involve teams of scientists examing the physical, chemical, and biological processes affecting the movement and fate of the contaminants in a variety of ground-water environments.

In addition to these research efforts to study processes of contamination, the Survey is beginning a long-term national appraisal of ground-water quality. The objective of the program is to assess the quality -- emphasizing organic contaminants and trace metals -- of the Nation's ground-water reserves. This will be done by intensive study of individual areas that are representative of larger regions in terms of climate, ground-water hydrology, and human activities.

Another element of the Toxic Waste/Ground-Water Contamination Program involves assistance to State agencies and to other Federal agencies in developing guidelines for managing hazardous waste disposal. This assistance will be provided as requested and will consist of advice in the technical aspects of waste management.

Significant findings of the Federal/State Cooperative Program and of Federal programs which preceded the Toxic Waste/Ground-Water Contamination Program have been published in numerous reports. These included several reports on ground-water contamination and aquifer reclamation at the Rocky Mountain Arsenal, Colorado; description of the microbial ecology of a creosote-contaminated aquifer at St. Louis Park, Minnesota; and the development of an optimal management model for multiple ground-water pollutant sources.

o Acid Rain

The U.S. Geological Survey has ongoing programs that are providing the basis for insight on the issue of acid rain. The Benchmark Network Monitoring Program is composed of 42 small drainage basins which encompass a wide variety of natural hydrologic environments. These basins are in a nearly natural state, with little human influence and little likelihood of future development. The Benchmark Program initiated in the mid-1980's is designed to answer the question, "What is the hydrology and water quality in small basins which are in a near-natural state, with little or no change in land use?"

Based on data from the Benchmark Network, the U.S. Geological Survey has found that trends in sulfate and alkalinity concentrations in small streams are consistent with reported sulfur dioxide emissions in the United States for the period 1965-1980. In the northeast, the sulfur emissions have decreased and the computed trends in stream data are consistent with slightly decreased concentrations of sulfuric acid in precipitation and a resulting slight recovery of stream buffering capacity. In contrast, sulfur emissions have increased in the western, central, and southeastern parts of the country, and the trends in stream-quality data are consistent with slightly increased concentrations of acid precipitation and a resulting slight loss of stream buffering capacity. The results indicate that the effects of relatively small changes in atmospheric emissions are observable in the quality of streams, an issue that has been the focus of much debate recently.

o Geologic Research and Development

Most geologic-related research and development activities are conducted in support of program elements that are not strictly classified as environmental research and development. Following are a number of such activities.

- The Geological Survey has developed methods for characterizing environments for emplacing waste using surface seismic methods, high-frequency electro-magnetic methods, borehole geophysical logging, acoustic and electrical techniques, and high-resolution electromagnetic sounding methods.

- Baseline studies of the chemical composition of soils and vegetation in pilot plots simulating coal and oil shale development have been conducted by the Geological Survey's Geologic Divsion, along with similar geochemical studies associated with mineral resource assessment. These studies provided background information on pre- and post-development elemental composition in soils and vegetation. Thus, Geologic Division expertise in the fields of environmental geochemistry, biogeochemistry, and plant physiology is being coupled with expertise on hydrology and ground-water transport in the Geological Survey's Water Resources Division to prepare a proposal to assist the Department of Energy in defining the distribution and concentration of some environmentally important heavy metals. The operation of several highly specialized heavy industrial facilities at the Oak Ridge Reservation in Tennessee has resulted in the possible release of some biologically important heavy metals to the local environment. The proposed investigation will establish a sound scientific basis for any necessary remedial activities in the areas of public health and land-use planning.

- The Geologic Division conducts, through its Climate Program, basic research that provides prehistoric geologic information bearing on the natural variability of past climate. This information is used to assess if or how much man's activities are influencing natural patterns of climate change.

- One of the larger and more important Geological Survey program is the geologic hazards program. This group of activities is important to many parts of the Nation. Included is the Geological Survey part of the National Earthquake Hazards Reduction Program, conducted jointly with the Federal Emergency Management Agency, the National Science Foundation, and the National Bureau of Standards. In this program, the Geological Survey monitors and conducts research in seismic activity, earthquake prediction, and other earthquake-related matters.

- The Geological Survey also has a significant program in studying volcanic hazards. This program has resulted in accurate predictions of the eruptive activity of Mount St. Helens and Kilauea.

- Research is conducted as well related to ground failure such as landslides, and construction hazards in locations where there are unstable geologic environments, and in hazards relating to planning for and operation of nuclear reactors.

- Information Dissemination

  o The Geological Survey has several mechanisms for conveying the results of its water-resources programs to elected officials, State and Federal resource management agencies, university and private researchers, and the general public. First, the Survey has its own formal publication program which includes Water Supply Papers, Professional Papers, Circulars, and Hydrologic Atlases.

  In addition, Geological Survey scientists publish articles in various professional journals. Second, the Federal/State Cooperative Program provides an excellent mechanism for the transfer of study results. Presently, the Survey has over 500 water-resource cooperators at the State, regional, and local level; each of these cooperating agencies is regularly in contact with our State offices concerning ongoing projects. Third, on behalf of the Department of the Interior, the Survey officially coordinates the water-data aquisition efforts of all Federal agencies. Since 1964, under the authority of OMB Circular A-67, the Office of Water Data Coordination of the Survey has coordinated this vital Federal activity through two advisory committees -- the Interagency Advisory Committee on Water Data (Federal) and the Advisory Committee on Water Data for Public Use (non-Federal). The membership of each committee provides for bringing results of programs to all sectors of the field of water resources. Lastly, the Survey frequently has the opportunity to brief Congressional committees on its programs.

There are only some of the environmental research and development related programs of the Geological Survey. Total funding in the Geological Survey in recent years for such programs has been computed as follows:

Fiscal Year 1979	$54,517,000
Fiscal Year 1980	$61,285,000
Fiscal Year 1981	$72,068,000
Fiscal Year 1982	$62,879,000
Fiscal Year 1983	$64,238,000
Fiscal Year 1984	$61,394,000

Bureau of Mines

The nation's minerals sector—the foundation of our industrial and defense base—is the concern of the Bureau of Mines. Our data collection and research activities are targeted at supporting the minerals sector's ability to meet the Nation's minerals needs.

When we think of Bureau research, we can consider a triangular relationship, with materials at one point, economic efficiency at another, and environmental concerns at the third point. The Bureau's activities fall within that triangle. Any one project must consider all three aspects of a process: how do we get the most materials, what are the costs, and what are the environmental concerns? Health and safety concerns, of course, overlie all of the activities. Thus, all research projects of the Bureau have, in varying degrees and mixes, materials recovery concerns, economic concerns, environmental concerns, and health and safety concerns.

In keeping with President Reagan's April 1982 Materials and Minerals Program Plan, the Bureau supports long-term research, of high-risk potentially high-payoff technology that has the best chance for wide generic application. The Bureau cooperates both with private industry and with university research efforts. Our research is carried out at ten research centers. Four concentrate on mining research, addressing conservation, development, and health and safety. Six concentrate on mineral and materials research, addressing extractive metallurgy and materials and recycling technologies.

In addition, the Bureau oversees the Mineral Institute program. That program's mission is to improve the quality of mineral engineering education through support for research in mining, metallurgical processing, and related mineral sciences. Designated institutions of higher learning having a substantial graduate program of instruction and research in mineral science and engineering are eligible to receive support through this program; 31 institutes have been designated. In 1982, generic mineral technology centers (each with several other university affiliates and industrial and Bureau of Mines participation) were set up for mine systems design and ground control, pyrometallurgy, comminution, and mineral industry waste treatment and recovery. In 1983, a fifth mineral technology center for respirable dust research was established.

In the overview of Bureau research which follows, it should be emphasized once again that all of the programs are closely interrelated.

Health and Safety research contributes to the technology base necessary for improvement of the working conditions of miners. In this area, the Bureau works closely with the Mine Safety and Health Administration, the National Institute for Occupational Safety and Health, State agencies, foreign mining research organizations, and the mining industry.

--In Health Engineering Technology, respirable coal mine dust, with its potential for enormous future human and economic costs, continues to be a problem of paramount concern. High-priority research is also conducted on other health hazards, including noise, toxic gases from diesel equipment and explosives, radiation in uranium mines, and excessive heat in very deep mines.

- --In Safety Hazard Reduction, major emphasis continues on falls of roof and rib, the single greatest cause of mine fatalities. A second major effort addresses accidents involving interactions of miners and equipment. The remaining effort is on problems dealing with the prevention of mine disasters.

Mining Technology studies ways to mine low-grade mineral deposits that are now unmined and would remain unmined without innovative advances. It also includes research on how to minimize problems associated with waste disposal, mine waters, and reclamation. Again, Bureau researchers work closely, if not in actual cost-sharing programs, with industry, academia, and other government organizations.

Technical emphases for this program were derived from the recommendations of the Committee on Mineral Technology of the National Academy of Sciences. Most of the technical areas recommended for study by the Academy have been incorporated into the program:

--more efficient materials handling required in surface mining operations;

--reduced environmental impact of mine waste materials;

--improved understanding of rock behavior, as it relates to production and dimensions of supports and openings;

--continuous, high-speed mining methods; minimizing surface disturbance caused by mining operations;

--investigation of rock mechanics and rock properties to improve mine design technologies.

Major recent accomplishments and developments in this program include:

--Developed a method to reduce significantly acid at its source, thereby reducing the potential of acid mine drainage before it occurs and the costs of treatment. At the Committee's request, we have included a briefing paper on the acid mine drainage research, attached as Exhibit 1 to this statement.

In essence, acid mine drainage is the result of water percolating through mines and mine refuse piles, creating an acid which is then carried along with the water.

Bureau research won Pollution Engineering magazine's 5-Star Award in 1982 for its work in acid mine drainage, which is described in detail in the materials we would present to the Committee for inclusion in the record.

--Another very important research area is in-situ mining. Briefly, in-situ mining consists of injecting a suitable solution into the ore zone below the water table, and recovering the pregnant solution (through production wells) now containing mineral values it has "picked up" from the orebody. If the particular orebody is amenable to the technique, it can be a very viable economic, environmental and highly efficient alternative to conventional open pit of underground methods. In-situ leach mining is a relatively new method that has the potential of recovering a variety of mineral commodities such as copper, uranium, gold, silver, manganese, and nickel. This mining method can be applied to smaller or lower grade deposits that would otherwise not be mined. Again, we would submit materials on this research to the Committee for the record.

Improved mining methods lead to greater economic efficiency, as ways are found to mine lower-grade ores, and to recover more of the ore from the waste rock. Improved design leads to lessening of environmental impacts. And, of course, improved design leads to greater minerals production.

With its Minerals and Materials Research, the Bureau seeks to provide information on the fundamental scientific and engineering principles of minerals processing. Both generic research applicable to a broad range of mineral problems and more specific research addressed to the recovery of vital minerals from domestic ores, particularly those that have both economic and national security importance to the United States, are conducted. The work provides data that may lead to techniques to reduce energy requirements and improve resource recovery.

Materials and recycling technology aims at improved service life or performance of materials, through better corrosion-, oxidation-, wear-resistant properties. Secondly, it studies technologies that might make available alternate or substitute materials for applications requiring imported strategic and critical materials, including chromium, cobalt, manganese, platinum, and refractory-grade bauxite.

Again, the "triangle" concept is applicable. Mining and mineral processing are among the highest industrial consumers of energy. As more efficient, less energy-intensive ways of converting ore to metal are found, materials recoverability increases, and environmental impacts are lessened.

Examples of Minerals and Materials Research projects are:

--High Temperature Thermodynamics and Kinetics: to develop and evaluate alternative mineral processing techniques requires a sound knowledge of the plausibility of proposed reactions and the rates of these reactions in the temperature range of interest. This project emphasizes the kinetics and thermochemistry of mineral systems at temperatures greater than 1,000° C and at pressures exceeding one atmosphere.

--Comminution Principles: comminution, or size reduction, is the single most energy-intensive step in minerals beneficiation, and, because it determines particle size distribution, has a direct bearing on the efficiency of downstream processes. The increased tonnage of a lower grade ore that must be ground to maintain the same amount of concentrate has sparked a continuing industry research effort to make improvements in grinding mill circuits. However, revolutionary improvements in grinding technology are unlikely until a better understanding of breakage and transport of particle assemblies is available. To supplement the extensive fundamental research efforts by the academic community, this project is directed toward obtaining basic size reduction data on selected mineral systems in order to pave the way for reducing energy consumption and improving the size liberation characteristics of the ground material.

- --Chromium-free and low-chromium alloys as substitutes for stainless steels: this work is directed toward devising substitutes for important alloys without degrading their chemical or physical properties.

- --Preparation of asbestos substitute multi-strand glass fibers: the objective of this work is to prepare 100 strand fibers of an experimental alkali-resistant glass fiber made from slate and limestone raw materials. Comparisons of the experimental fibers with those available commercially will be made to determine the suitability of the experimental materials as asbestos substitutes in reinforcing applications.

- --Critical metals recover from grinding wastes: the objective of this work is to devise and test economically feasible techniques for recovering cobalt, nickel, chromium, and other values from grinding sludges.

- --Dewatering of mineral processing slimes by flocculation: this research is concerned with developing techniques for dewatering slurries from mineral processing operations to improve water reclamation and for producing dewatered solids suitable for disposal. The effort will be supported by basic research on the bonds formed between clay particles and polymer flocculants.

Finally, results of the Bureau's research are disseminated to mineral and related industries and other users, researchers, academicians, federal, state and foreign government agencies through:

- --Technology Transfer events, such as seminars and briefings, designed to give industry an opportunity to hear about Bureau programs and developments first-hand, from the men and women who are actually conducting the research and development in Bureau laboratories. In FY 1983 the Bureau conducted 14 such events before a total audience of 1,370 representatives of industry and other potential users of Bureau-developed technology. In the past ten years the Bureau has reached a total audience of 11,400 through 123 Technology Transfer meetings.

- --In addition, our work is made available to users via the Bureau's own extensive publication series, through papers presented at technical meetings and published in technical and trade journals, Technology News, brief published summaries, and through press releases.

Briefing Paper: Control of Acid Mine Drainage

Background:

Acid drainage is one of the most persistent industrial pollution problems in the United States. It results from the exposure and subsequent oxidation of sulfide minerals (primarily pyrite). Mining companies spend millions of dollars annually to treat acid water, and typically this expenditure continues long after mining has ceased. As an alternative to treatment, the Bureau of Mines has developed a method to reduce the rate of pyrite oxidation, thereby eliminating the acid at its source.

New Technology:

A simple and inexpensive method has been developed: a dilute surfactant (detergent) solution, such as sodium lauryl sulfate (SLS), is applied directly to the acid-forming material using a hydroseeder or road watering truck. This procedure is repeated three times a year as a preventive measure to avoid a potential acid drainage problem or to reduce water treatment costs from an existing problem area. The surfactant prevents the acid formation by inhibiting the growth of an iron-oxidizing bacterium, Thiobacillus ferrooxidans, a biological catalyst in the oxidation of pyrite.

Field tests were conducted in FY82 at active and inactive coal refuse areas. Water quality at the active site improved dramatically within a month of the SLS application and remained good for four months after treatment. At the inactive site, water quality improved after a three month lag period; acidity, sulfate and manganese decreased 60 pct, while iron concentrations decreased by 90 pct.

At a material cost of about $200/acre applied only a few times a year, the procedure quickly pays for itself by reducing water treatment costs. For example, at the field test on the inactive refuse pile , water treatment costs were lowered by $7,500 a month.
40-50 coal mine operators have started to use the technique on coal refuse areas or exposed pyritic overburden.

Other Applications:

Metal-sulfide mines of the western United States, which generate acid water of even poorer quality than that produced by coal mines, have also expressed interest in the procedure. It is our hope that in the future we will be able to evaluate and modify the technique so as to extend its applicability to these metal mines and associated tailings piles.

We are now in the process of field testing a related procedure to control acid production from abandoned or inactive mine lands where a long-term solution is required. We have developed surfactant-rubber compositions which release a little of the surfactant each time it rains. This time release concept is somewhat analagous to the flea collar approach for household pets. Ideally, surfactant release should last at least five years to provide sufficient time for non-acid soil biota to become fully established. We have demonstrated that the system works in pilot scale tests and have recently begun full-scale field tests of the technique. A sample of the time release pellets is attached.

Other Control Methods:

To reduce the incidence of acid drainage in the future, the Bureau is working with state regulatory agencies and industry to improve predictive technology. Related to this work are studies to determine where or when oxygen or water limit acid production and how these limits can be incorporated into mining and reclamation plans. We anticipate that within two years our research will allow surface mine operators to identify potential acid problems before mining, and to prevent acid drainage wherever possible.

We are also in the process of developing an at-source control procedure for acid-producing underground mines. Instead of surfactants, which would eventually wash away, we are testing organic compounds which inhibit T. ferrooxidans but which also react with acid drainage to form a sticky precipitate. We intend to test one or two of the compounds this summer, spraying the material as a fog into an accessible abandoned section of an underground mine. If the fog successfully penetrates all of the cracks and fractures and inhibits the bacterial activity, acid production should be reduced.

Finally, for sites where at-source control is not possible, we are conducting research to reduce the cost of water treatment. For example, we have developed aeration systems which are simpler and cheaper than conventional mechanical aeration. Currently, we are testing the potential use of sphagnum moss bogs to treat small acid seeps naturally. The sphagnum moss removes the iron from the acid water, allowing neutralization by limestone rubble, which would otherwise become coated and soon lose its capability to react.

U.S. Bureau of Mines

FISH AND WILDLIFE SERVICE

Attachment

The research and development effort in the Fish and Wildlife Service addresses information needs related to specific program areas: Wildlife, Fisheries, Endangered Species and Habitat Resources. The following sections explain in more detail the research being conducted by the Fish and Wildlife Service.

Wildlife Research

Objectives:

1. To conduct research on migratory birds which will provide techniques for preserving and managing habitat; population information needed for development of sound harvest regulations; biological and ecological information necessary for proper management of non-game birds; information and field response for reducing non-hunting mortality; and methods for assessing the impact of different types of land use and development on avian populations.

2. To develop the understanding of functional relationships of wildlife species and their ecosystems necessary to properly manage resources.

Base Program: Wildlife research provides the Service with basic biological information about species numbers, population dynamics, ecological relationships, and habitat requirements. This information allows for the establishment of prudent hunting regulations, description of essential habitat, identification of populations in danger of becoming threatened, development of optimum land use management programs, reduction of non-hunting mortality, assessment of environmental impacts, adequate mitigation of habitat losses, and increased opportunities to utilize and enjoy the resource.

Wildlife research is conducted at four laboratories and 36 field stations.

Recent wildlife research outputs are:

- A synthetic fermented egg formulation was identified and is in use as a superior lure for coyote control work, as well as at census stations.
- Development of an aerially-applied fluorscent mass-marker for use on birds that congregate in large groups has been useful in identifying local and regional populations of problem blackbirds.
- The toxic collar for selective control of depredating coyotes was completed. This tool selects individual coyotes that cause problems out of the general populations.
- Combined influences of agricultural land use changes, and losses to predators were identified as significant limitations to recruitment of ducks in the prairie potholes.

- A 15-year synthesis of results of the Breeding Bird Survey has provided population trend data on many species of migratory birds. It will serve as a benchmark for future changes in non-game bird populations.

- A 3-year study of the effects of the hunting of mourning doves was completed. This cooperative State-Federal effort will allow both State and Federal management authorities to be on firmer ground in supporting early season hunting of this important game species.

- An Atlas of Wading Bird and Seabird Colonies for Alaska, Eastern, and Gulf Coasts was completed.

- The Seney National Wildlife Refuge experienced a major fire that devastated much of the refuge. A three-year investigation of the effects of this fire was the first intensive investigation of the effects of such an event and will lead to both fire management techniques and post-burn management practices.

- Surveys of non-game species on four National Wildlife Refuges (White River, St. Marks, Kofa, and Cabeza Prieta) were completed. This information will allow specification of the effects of waterfowl and other game-species management on the entire complex of species that use these and similar refuges.

- Studies on the effects of road vehicles on desert systems were completed. These efforts serve to provide land managers with guidelines for allowing access to public lands for recreational use of public lands.

Fishery Research

Objectives:

1. Provide scientific data and related synthesis for application in the cooperative resolution of problems associated with the use, protection, and perpetuation of freshwater and anadromous fishery resources, especially those found in international or interstate waters or waters on Service lands.

2. Provide information, methodology, and materials to assist fishery managers in decisions about protection, enhancement, and utilization of the Nation's fishery resources;

3. Collect, collate, and interpret diverse information on fish species, populations, and habitats to address specific needs of the Service;

4. As feasible, respond to the needs of other Federal agencies, Indian tribes, State agencies, international groups, and private organizations involved in fish culture.

Base Program: Fishery research promotes the wise use of the Nation's freshwater and anadromous fish populations and improving the management of fish and wildlife resources through greater reliance on objective scientific information. Fulfillment of this mission requires a research and development function that can yield the many kinds of technical information required. Service capacity to assist management in addressing complex resource questions is derived fundamentally from biological research and technological progress.

Within the scope of Service mission and responsibility, fishery research concerns fall into three major categories: habitat, resource use, and fish husbandry. Related objectives guide the investigational effort of the Service's Fishery Resources Program, including research, development, and extension functions.

The habitat category of investigation is aimed at describing interactions of species and determining the effects of changes in their environment. Habitat objectives pertain primarily to fishery resources (1) represented by species of special Service emphasis; (2) that are environmentally impaired, depleted from overuse, or generally imperiled; and (3) that are anadromous and/or inhabitat transboundary or federally managed waters (e.g., national wildlife refuges, national parks, etc.).

The resource use category of investigation is aimed at providing technical information and references for the assessment and allocation of fishery resources, including parameter estimation and population modeling. The objectives pertain primarily to fishery resources (1) represented by species of special Service emphasis; (2) that are depleted from overuse, environmentally impaired, or generally imperiled; and (3) that are anadromous and/or inhabit transboundary and federally managed waters (e.g., national wildlife refuges, national parks, etc.).

The fish husbandry category of investigation supports the predation and culture of fishes at Service hatcheries, with spin-off application in State and private (aquaculture) sectors. Activities include research on such things as fish production, health, genetics, carrying capacity of hatcheries, performance of stocked fish, and compliance with NEPA/NPDES permits.

To assist in attaining Fishery Resources Program goals and objectives, the Service operates one national fishery research center consisting of 5 satellite research laboratories, 4 other major laboratories, and 28 field stations.

Recent fishery research outputs are:

- The National Aquaculture Development Plan was developed in response to Congressional directive, this document was jointly produced by SUDA, USDC, and USDI. In Volume I, it provides a review of the present status of aquaculture and outlines programs for future U.S. development by all participating sectors.

- Microscopic Anatomy of Salmonids: An Atlas: This landmark product will be extremely useful to fishery managers and fishery producers in the ares of disease control, genetics, nutrition, effects of toxins, and other problems.

- The FWS continues to provide the initial development for fish immunization. The latest vaccine to be developed is one for Furuncolosis. After initial development by FWS the process is turned over to private industry for further development and commercial production.

- Mitigation and Enhancement Techniques for the Upper Mississippi River System and Other Large River Systems: This is a landmark publication and is tailored for use by water development planners, developers, and conservationists. It will assist in understanding the potential effects of water development projects and provide guidance in mitigating damages.

- Atlas of North American Fishes: This is an 854 page atlas of all freshwater fishes of the United States and Canada. It should serve as a major source of fish distribution information and is a source of baseline information about the current status of populations against which to judge future changes.

- Atlas of the Spawning and Nursery Areas of Great Lakes Fishes: This Atlas will be especially useful in the development of the Great Lakes-St. Lawrence Seaway Navigation Extension Program as well as other projects affecting Great Lakes habitat.

- Status of the Fishery Resource in Treaty-Ceded Waters: This report was developed by the Tripartite Technical Working Group (Indian tribes, State of Michigan, and FWS) on the assessment of major fish stocks on treaty-ceded waters of the Upper Great Lakes-State of Michigan. Through products such as this, the conflict between various user groups is being settled. Similar reports will be prepared in succeeding years.

Endangered Species Research

Objectives:

1. To identify and evaluate environmental and biological factors that limit endangered species populations.

2. To augment or establish wild populations by introducing stock produced through captive propagation.

3. To develop, improve, or refine management procedures that enhance the survival of endangered species.

Base Program: Research is conducted to develop the tools and techniques to more effectively managed listed species. These research investigations use both in-house expertise and outside contractors to conduct (1) in-depth studies of individual species or groups of species within a given ecosystem, (2) habitat evaluations, (3) identification of limiting factors, and (4) other actions identified in recovery plans as essential to species recovery.

Recent Endangered Species research outputs are:

- The techniques for propagation and successful reintroduction of Aleutian Canadian geese were developed and have been an integral part of the success of the restoration of this species.
- Successful procedures for bringing California Condors into captivity were developed to establish a breeding colony for the production of young for reintroduction into the wild.
- Developed a Hawaiian Forest Bird Survey with density and population estimates plotted on detailed vegetation maps has allowed State and Federal authorities to clearly focus management efforts on those habitats and species that are most critical.
- Propagation techniques for bald eagles have been developed and implemented. These have led to the successful fledging of young in several states in which no young have been produced naturally in the past 15 years.

Habitat Resources Research

Objectives:

1. To conduct applied research studies to identify and provide scientific information on fish and wildlife populations and ecosystems of high Federal interest and concern that are adversely affected by contaminants.

2. To recommend corrective measures and/or management alternatives to reduce the exposure of fish and wildlife to environmental contaminants.

3. To develop, maintain, and transfer of ecological information to Federal, State, and private users, to address fish and wildlife habitat and resource issues of National and Regional importance, and to minimize and mitigate the effects of development on those resources.

4. To provide technical assistance and training to resource managers and other decisionmakers who use ecological information and tools to effectively manage fish and wildlife resources and their habitats.

Base Program: The Service's contaminant research subprogram focuses on fish and wildlife resources of high Federal interest or concern. This effort provides Service-wide support to all programs to identify, evaluate, and resolve fish and wildlife impacts of management concern resulting from exposure to environmental contaminants. This work is conducted at three laboratories that supervise 14 field stations.

Interagency agreements have been established with EPA and NOAA to avoid duplication of effort and to ensure coordination on matters pertaining to fish and wildlife resources and environmental contamination.

The responsibilities of R&D in the Biological Services area include the formulation and development of analytical tools and methodologies, their application, and the dissemination of research and developmental results and information, based on identified needs for fish, wildlife, and habitat resources. The effort will increasingly focus on the development of information through applied research and the development of methodologies and technologies that increase the efficiency and precision of data collection and analysis; facilitate the availability, effectiveness, and use of scientific information; and foster exchanges of information among resource management agencies at the Federal, State, and local level. The major areas of activity for which this information is developed include energy (e.g., Federal coal, OCS oil and gas, and hydropower retrofitting and low-head dam development); water transportation (slurry pipeline, waterway, and port development); and significant fish and wildlife habitat deterioration due to changing land use or other developments. These activities are accomplished so that information is available in the earliest planning stages to support consultation activities of FWS operational personnel and to support any following general investigations, permit reviews, or expert advice provided to other Federal agencies. The effort is carried at 3 field locations.

Recent Habitat Resources research outputs are:

- Identification of some acute and sub-lethal impacts of agricultural chemicals, heavy metals, and other hazardous materials to fish and wildlife. For example, the correlation between bent backbones and chemical stress was developed by FWS.

- Identification of the impact of oil pollution on fish, waterfowl, sea turtles and other vertebrates has been important in assessing the effects of oil spills.

- Investigation of the pathways by which contaminants affect fish and wildlife species, i.e., the routes of bioaccumulation.

- Service research has been instrumental in the documentation of the impacts of acid rain on the fish population of lakes in the Northeast Central states.

- A National Wetland Classification and the National Wetland Inventory methodology have been developed and transferred to operational units of the Service.

- The Habitat Evaluation Procedures, have been developed and have been adopted by the Fish and Wildlife Service, Corps of Engineers, and Soil Conservation Service.

- A variety of maps, including the Ecological Inventory Series which displays national resource information for the Atlantic, Pacific, and Gulf coastal areas, are now being sold by the USGS. Other maps include computerized maps and analytical tools for coastal areas;

resources impacted by OCS oil and gas development; resources affected by Federal coal lease; and maps of wetland change in many parts of the U.S. These maps are being used by a variety of State and Federal agencies.

- A review series on the effects of acid precipitation, including a handbook on liming as a potential tool to mitigate the impacts of acid precipitation was produced.

- The atlas to identify developed and underdeveloped barrier islands under Coastal Barrier Resource Act was developed.

Cooperative Research Units

Objectives:

1. Provide a medium for Fish and Wildlife Service, other State, and university cooperators to conduct cooperative research on resource management issues of high priority.

2. Provide, through advanced training, an adequate complement of highly trained resource managers.

3. Provide technical assistance and promote conservation education for the cooperating agencies on programs related to the conservation and understanding of fish and wildlife and their habitat.

Base Program: The Cooperative Unit Program is made up of 25 Fishery Units, 20 Wildlife Units, and 4 Combined Fish and Wildlife Units located at 31 universities in 29 states. The Program carries out a diverse array of research projects on resource management problems of great significance to the Nation and the States in which the individual units are located. An integal part of this program is training graduate students through classwork and research experience, as well as providing technical expertise and assistance to all of the Program's cooperators.

Results of research done by the Units are transmitted to appropriate Federal and State conservation agencies, and are used in active management of fish and wildlife resources across the United States.

Recent Cooperative Units research outputs are:

- Transplanting whooping crane eggs to sandhill crane nests was successful in the wild. As a result the Service has been successful in accelerating the rate of population growth of a species that is the symbol of the endangered species in the U.S.

- The findings that Mississippi Valley Canada geese and lesser sandhill cranes do not reproduce until much older than previously though have led to adjustments in management strategies so harvest is brought into balance with productivity. Thus the FWS and several midwestern states are more effectively managing these resources.

- Information developed on the ecology of the spotted owl and other species that are obligatory forest inhabitants in the Northwest has provided the Forest Service and private timber companies with better information with which to construct management guidelines for the harvest of old-growth forests in the Pacific Northwest.

- Coastal marshes were identified as important nurseries for commercial and sport fish species. Armed with such information the Service is in a better position to protect wetlands by pointing out their economic value.

- Technical support was provided to Judge Boldt on Indian Treaty fishing rights in the Pacific Northwest. Service expertise was instrumental in balancing sound resource management with the rights of native Americans to traditional fisheries.

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JAN 30 1984

Honorable Robert T. Stafford
Chairman, Committee on Environment
and Public Works
United States Senate
Washington, D. C. 20510

Dear Mr. Chairman:

Enclosed please find additional information requested at the hearing before the Subcommittee on Toxic Substances and Environmental Oversight held October 17, 1983, regarding environmental research.

The enclosed information has been prepared for insertion in the record at the points indicated thereon.

Thank you for the opportunity to provide this material to the Committee.

Sincerely,

Linda C. Moore

Linda C. Moore
Acting Legislative Counsel

Enclosure

Reply to question submitted to Dallas Peck by Senator Durenberger

Question: The U.S. Geological Survey maintains national streamflow and stream quality networks that have generated information that has been of significant use in many ways to both public and private sectors. In view of the importance of our ground-water resources and the frequency of reported contamination, could not a similar data collection network be established for major aquifers throughout the Nation?

Unlike surface streams that are relatively easily monitored at fixed sites to provide information about regional changes in water quality, a national network for ground-water monitoring would be a costly and ineffective method of evaluating the status of ground-water contamination. Ground-water velocities are usually very small, and pollution of ground water tends to occur in slowly developing plumes around point sources of contamination, or in shallow, slowly expanding zones beneath areas of nonpoint pollution. Because of the nature of the emplacement process, the actual volumes of contaminated ground water tend to remain small for long periods of time in comparison to the total volume of ground water circulating through the earth.

Thus, a monitoring strategy based on water samples collected from any practical array of observation wells would fail to detect most developing contamination problems until a great deal of damage had been done. As an alternative strategy to fixed station monitoring, the USGS has undertaken studies of areas where point and nonpoint sources of pollution are known to be affecting ground-water quality. In this approach, which the USGS has taken in virtually all of its work related to ground-water contamination, the distribution of contaminants is analyzed in terms of the hydrologic and geochemical processes affecting the movement of water and its constituents. In many cases, this approach has led to a capability for predicting the further movement and fate of the contaminants in the ground-water system.

Most of our work in the area of ground-water quality monitoring has been carried out in conjunction with specific investigative projects, which we have undertaken in cooperation with State or local governments, or on behalf of other Federal agencies. Almost all of these projects have been in areas where a contamination problem was already recognized; almost all have involved a considerable degree of analysis and interpretation, in addition to the monitoring effort. This is in fact an essential characteristic of any attempt to evaluate ground-water contamination; a simple monitoring effort, without analysis and interpretation, is virtually guaranteed to fail, if for no other reason than that directions of flow away from a contaminant source must be understood before an efficient monitoring program can be designed.

QUESTIONS FOR DR. DALLAS PECK--DEPARTMENT OF INTERIOR

Submitted by Senator Durenberger

QUESTION 2 The Administration has placed increased emphasis on public and private cooperative efforts. The Bureau of Mines' research activities have yielded innovative mining practices and acid mine drainage control methods that would be of significant benefit to the mining industry. Has the Bureau successfully developed cooperative research arrangements with the private sector?

ANSWER: The Bureau of Mines research activities have yielded promising results in the control of acid mine drainage (AMD), but the progress to date has only been possible through the cooperation and assistance of the mining industry. Bureau specialists have worked with mine operators, state environmental control groups, and potential vendors; in the case of mine operators, initial contacts and preliminary site assessment have quantified the nature and magnitude of the problem and the probability that new Bureau technology can assist in controlling acid mine drainage problems. Then at the most suitable sites formal agreements are developed; at this time approximately six sites are under preliminary assessment and there are six formal agreements relative to the control of acid mine drainage. This research relates to the application of sodium lauryl sulfate (SLS) to coal or coal refuse to destroy a bacterium which catalyzes iron production. The application of SLS has had a dramatic decrease on the acidic and iron content of effluent from coal refuse sites. Included in these efforts is the assessment of the SLS technique to metal and nonmetal mines, with the initial efforts being conducted in a clay mine operated by Kaiser Aluminum and Chemical Corporation.

Another aspect of the acid mine drainage program involves problems of water treatment. Recent results from an agreement with the Shannopin Mining Company have shown that the Bureau developed treatment of mine water discharge could eliminate the need for the aeration system, resulting in significant saving in capital cost and reduced operating costs.

These efforts have also permitted close cooperation with the States of West Virginia and Pennsylvania. In the case of West Virginia, the State has contributed $200,000 to assist in the refinement of the Bureau developed techniques.

In addition to the work described above on the control of AMD, the Bureau funded work on the premine prediction of AMD is only possible through the active participation of about 30 mining industry cooperators. It is anticipated that this work will permit premine planning regarding the nature and control of acid producing material.

It is important that the results of this successful research be made available as soon as possible to all segments of the mining industry and to potential suppliers and consultants. Toward this objective the Bureau conducted an Acid Mine Drainage Seminar on October 28-29, 1982, at which over 300 industry representatives participated. Continued success in the ongoing research will dictate another AMD seminar in the near future to continue this technology transfer effort.

In addition to research in Bureau of Mines laboratories, the Bureau also sponsors the Generic Mineral Technology Center for Mineral Industry Waste Treatment and Recovery at the University of Nevada-Reno, with affiliated Universities of Idaho, Montana, Iowa State, and New Mexico Tech.

QUESTIONS FOR DR. DALLAS PECK--DEPARTMENT OF INTERIOR
Submitted by Senator Durenberger

QUESTION 3 Describe in some detail what cooperative efforts exist between the USGS and EPA's Office of Drinking Water in the area of ground water contamination.

ANSWER: The U.S. Geological Survey (USGS) and the Environmental Protection Agency (EPA) have developed a number of mechanisms to facilitate cooperation and the sharing of expertise between the agencies. Each of these can be utilized for cooperative efforts in support of EPA's Office of Drinking Water. Principal mechanisms include:

a. A Memorandum of Understanding creating a standing Interagency Coordinating Committee. This Committee has been established to coordinate activities in areas of common interest, facilitate information exchange, and resolve conflicts between the two agencies. The function of the Committee is to:

   ° Provide a coordinating mechanism for programs and multiyear plans of the two agencies. Programs of mutual interest include, but are not limited to: surface- and ground-water hydrology with emphasis on water quality; geology; geochemistry; waste disposal; mapping; aerial photography; remote sensing; emergency response plans.

- ° Provide for technology transfer and exchange of data, information, and research findings of mutual interest.
- ° Arrange for cooperation and support in the conduct of programs of mutual responsibility and interest.
- ° Exchange appropriate budgeting and program planning information.
- ° Act as a clearinghouse for EPA/USGS contacts, and provide information on existing and future Memorandums of Understanding (MOUs) and Interagency Agreements (IAGs).

b. The agencies have developed an umbrella agreement to facilitate implementation of the other Agreements. The umbrella Agreement establishes:

1) The method for development and incorporation of the various subagreements,
2) mechanisms for fund transfer and accountability,
3) requirements for periodic, milestone, and final reports,
4) procedures for issuing environmental impact statements, publications, and press releases,
5) requirements for program evaluations, and
6) procedures for modifying or terminating the Agreement and/or any subagreement thereunder.

c) An Interagency Agreement has been established to assist the EPA's Office of Drinking Water in their responsibilities related to the designation of sole source or principal aquifers. Under the terms of this agreement, whenever an aquifer is under consideration for designation under Section 1424 (e) of the Safe Drinking Water Act EPA will so notify USGS in writing. Once the USGS has agreed to conduct a study in a specific area, the following types of information are furnished to EPA:

1) Maps and written description of the location and approximate boundaries of aquifer, recharge zone, and surface-water relations to the aquifer and an estimate of percentage of recharge contributed by infiltration and by surface water under existing conditions.

2) Hydrologic maps, graphs, and tables depicting: sensitive recharge areas such as glacial outwash or fractured rocks; directions of ground-water movement; distribution of transmissivity and porosity; depth to water and seasonal changes in water levels; coefficients of storage; well yields; locations of drinking water quality data; and in general any information leading to a characterization of the aquifer and the recharge zone which may later assist EPA and other Federal agencies in evaluating the impact of Federal financially assisted projects on the aquifer.

3) Background Data:

Population, cities, and towns presently dependent on the petitioned aquifer as their sole or principal source of water supply.

Possible alternative sources of water supply.

Public drinking water supplies in the area and treatment provided by such systems.

Present and projected water consumption from the petitioned aquifer.

d. The two agencies have a Memorandum of Understanding regarding activities related to degradation of the subsurface environment. The purpose of the MOU is to formalize cooperation and document agreements between the EPA and Department of the Interior (DOI) regarding their respective responsibilities for studying, utilizing, and, especially, protecting the subsurface environment. It is based on the premise that the USGS is responsible for developing information on the subsurface environment, including information on earth processes, distribution and composition of materials, and the sources, quantities, qualities, distribution, and behavior of ground water and other resources, and that EPA is responsible for establishing national criteria and standards, developing the regulations, augmenting State enforcement, monitoring quality as it relates to pollution control, and otherwise conducting or financing activities needed to prevent pollution of the subsurface. Within the limits and specification of this MOU, program directors of the two agencies negotiate directly to implement appropriate working arrangements, subject to approval by higher authority, for such items as legal interpretations, legislative proposals, program planning, joint investigations, and budgeting, including reimbursable funding.

e. An Intergency Agreement exists between the USGS and EPA's Office of Waste Program Enforcement for the purpose of dealing with the Resource Conservation and Recovery Act (RCRA). The purpose of this Agreement is to specify the cooperation and extent of assistance which the USGS will provide to the EPA, Office of Waste Programs Enforcement, in the gathering of information and assessment of the geology and ground-water conditions of hazardous waste sites. Under terms of this agreement the USGS has agreed to:

1) Provide from existing USGS files any area-specific ground-water data and supporting geologic data.
2) Provide technical assistance in reviewing plans of investigation for specific sites.
3) Review investigative reports and conclusions of EPA staff.
4) Comment, as appropriate, on remedial designs and predicted effectiveness of the designs.
5) Examine EPA case files and provide witness support in court proceedings, as necessary.

Other agreements between the USGS and EPA exist, in addition to the five agreements listed in this response. Among these is one pertaining to EPA's participation in the USGS-managed National Water Data Exchange (NAWDEX). The functioning of this Agreement and the others, as well, is overseen by the standing Interagency Coordination Committee and working groups of that Committee.

QUESTIONS FOR DR. DALLAS PECK--DEPARTMENT OF THE INTERIOR
Submitted by Senator Baucus

QUESTION 1 What is the U.S. Fish and Wildlife Service doing to coordinate their programs aimed at having the grizzly bear and wolf populations within the North Fork Flathead River Basin stabilized, with Canadian development such as the Cabin Creek Coal mine with the basin.

ANSWER: Wolf recovery in northern Montana is largely dependent upon natural dispersal from populations in Canada. Stabilization does not describe the objectives of the Fish and Wildlife Service (FWS) regarding the wolf population in the North Fork of the Flathead River Basin. Efforts are being directed toward increasing the United States (U.S.) population by encouraging unimpaired movement southward into Montana. This is done mainly through informal discussions with Canadian wildlife officials through the Border Wolf Technical Committee--a group of land managers and biologists representing Canadian provincial and American State and Federal agencies whose common interest is to preserve, protect, and manage Rocky Mountain wolf populations adjacent to the U.S.-Canadian border.

The British Columbia Fish and Wildlife Branch is considering reopening the hunting season on wolves in Southern British Columbia. Ray Demarci, British Columbia Game Manager, Kootenai Region, has indicated a willingness to delay opening the hunting season in the Flathead Drainage provided someone in the U.S. studies the population build up and resultant movements from the area. Dr. Robert Ream, University of Montana, has proposed a radio-tracking study of wolves that would satisfy the Canadians and at the same time provide information on wolf dispersal into the U.S. This proposal has been approved by the service for Section 6 Endangered Species money for FY-1984. The proposal is supported by FWS Endangered Species Offices in Idaho, Montana and the Denver Regional Office; the Idaho Department of Fish and Game; the Montana Department of Fish, Wildlife and Parks; and the Northern Rocky Mountain Wolf Recovery Team.

Due to extremely low numbers of wolves in the U.S. portion of the North Fork of the Flathead River Basin, opportunities to mitigate or compensate for Canadian actions that may impact wolves are limited. The study mentioned above will provide valuable information for making recommendations on ways to modify potentially harmful projects such as the Cabin Creek Coal Mine and for establishing positive recovery actions for the wolf on the U.S. side of the border.

FWS recently distributed the revised draft Northern Rocky Mountain Wolf Recovery Plan for technical review. This plan provides direction to help land management agencies establish wolf management zones in identified wolf recovery areas. Implementation of recovery actions outlined in the plan are probably the most positive actions FWS and other agencies can take at this time to facilitate wolf recovery and compensate for any adverse effects created by the Cabin Creek Coal Mine. Habitat requirements between wolves and grizzly bears are somewhat similar. The FWS efforts, through the Section 7 consultation, encourages that logging, oil and gas exploration and development, and other multiple-use activities be conducted in a manner that is compatible with the biological requirements of the grizzly bear and the wolf.

The FWS is coordinating grizzly bear recovery efforts in the North Fork of the Flathead River Basin along with all other occupied areas of grizzly bear habitat in cooperation with the U.S. Forest Service, the Montana Department of Fish, Wildlife and Parks, and Glacier National Park. This coordination effort involves identification of factors which may contribute toward the population decline of the grizzly bear. Two major factors have contributed to the population decline. These are (1) direct human-induced mortality, and (2) habitat displacement and destruction through the effects of human activity. Forest Service and National Park Service activities in the Flathead River Basin which may have an effect on the survival of the grizzly bear are subject to informal and/or formal consultation with FWS. The result of consultations is a review of the effects of these activities on the grizzly with the aim of modifying or reducing the detrimental effects, should there be any, to prevent jeopardizing the continued existence of the grizzly. An example of the formal consultation procedure was the review of the proposed paving of sections of the North Fork road. The formal consultation indicated that the project would jeopardize the continued existence of the grizzly and the wolf in the North Fork area. The result of this jeopardy opinion was that the paving project was canceled through the efforts of the Federal agencies involved. Projects on the Canadian side of the border are not subject to this type of review by FWS. The object of the Grizzly Bear Recovery Plan is the recovery and eventual delisting of the species within its occupied range in the lower 48 States. The habitat needs of the species are accounted for by the land management agencies in cooperation with FWS, but it is difficult to coordinate land management activities on the U.S. side of the border with an unknown level of potential development on the Canadian side. The survival of the grizzly bear in the North Fork Basin will be critically dependent upon the maintenance of contiguous grizzly populations throughout the Rocky Mountains northward across the border into Canada.

QUESTION 2 What levels and types of research are planned for the North Fork Flathead River Basin to allow the U.S. to adequately respond to Canadian development impacts? If no research is proposed, please identify how this decision will affect the status of fish and wildlife resources and water quality in Glacier National Park and the entire North Fork Flathead River Basin in the U.S. with particular emphasis on grizzly bears and wolves?

ANSWER: Various research projects on the grizzly bear have been underway since 1975 on the North Fork of the Flathead River Basin. Currently, Bruce McClellan, a graduate student from the University of British Columbia, has been conducting a long-term project, underway since 1978, immediately north of the U.S.-Canadian border along the North Fork of the Flathead. This project is examining the habitat needs, movements, behavior, population dynamics, and response to human activity of the grizzly bear population which inhabits the border area. This research project is centered in the area of the proposed Cabin Creek Coal Mine. There has been considerable information developed by the study since 1978. Currently nine bears are wearing radio collars in this area, and most of these bears move back and forth across the U.S.-Canadian border at some time during the year. The information gathered by this study will detail important baseline information on the population of grizzly bears in the area of the proposed mine site prior to its development. The FWS will contribute $2,000 to this study in 1984, specifically to obtain population dynamics information. This information is necessary to review the grizzly bear population size and trends in this area. Further FWS money may be committed in FY-84 to assist this study, if it is possible to obtain information on the four major research needs for recovery of the grizzly that have been identified by the Interagency Grizzly Bear Committee (IGBC). The four major resource needs identified by the IGBC are as follows:

1. Document the effects of human activities on grizzly bear behavior and habitat use specifically regarding: (a) oil and gas exploration and development (b) timber harvest and road management (c) recreation (d) livestock/grizzly bear competition and (e) sport hunting.

2. Development of a grizzly bear population trend monitoring system.

3. Development of a habitat suitability index and a model of optimum grizzly bear habitat that can be used by managers for habitat improvement opportunities.

4. Development of a technique for moving grizzly bears for possible population augmentation.

It is hoped that the use of the data gathered since 1975, combined with the ongoing work on the Canadian side of the border, can be used as baseline information prior to the proposed development. This information then could be used by managers to manage land and wildlife resources in order to provide for the continued existence of grizzly bears and wolves in the Flathead River Basin.

National Park Service base funding for research and operations in Glacier National Park has recently been allocated a substantial permanent increase, beginning in Fiscal Year 1984. This increase was justified in large part by the need to support research and monitoring efforts related to the potential impacts of development on the North Fork of the Flathead River in Canada. The park is currently developing plans and priorities for specific monitoring and research projects, including baseline water quality studies and research on possible impacts on park fish and wildlife species, which can be supported by this new allocation.

The National Park Service is also a participating member of the Flathead River Basin Commission, an interagency group which as been established by the State of Montana to provide overall coordination and direction to research and resource management activities in the Flathead River Basin. Commission members include 15 Federal, State, and local agencies which are represented in the Flathead River Basin. The Commission provides oversight in developing long-term monitoring objectives, identifying research priorities and coordinating agency activities in the area. This will ensure that agency funds, including those of the National Park Service, are used to efficiently and effectively respond to the potential impacts of the Canadian development.

STATEMENT OF

DR. J. CHRISTOPHER BERNABO
EXECUTIVE DIRECTOR
NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM

BEFORE THE
SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT
OF THE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

17 October 1983

Senator Durenberger:

Thank you for the opportunity to describe the statutory National Acid Precipitation Assessment Program and our recent annual report to the President and Congress. I serve as the Executive Director of the National Program while on assignment from the National Oceanic and Atmospheric Administration (NOAA) Administrator's Office of Policy and Planning.

The National Acid Precipitation Assessment Program is designed to successively improve our understanding of the causes, effects and possible solutions to the acid rain problem. The Program includes research, monitoring and assessment activities that emphasize the timely development of a progressively firmer scientific basis for decision making by the Congress, regulatory agencies, private sector managers, environmental groups, and the public. The National Program consists of over 200 projects and hundreds of scientists in government, academia, and the private sector.

My testimony includes descriptions of the authorizing legislation, the organization and implementation of the Federal acid rain research effort, a synopsis of the major accomplishments during the National Program's first two years of research, and the outlook for research progress through 1989. I will also expand upon the funding history for this interagency effort, as well as the extensive planning and coordination that is needed to ensure an integrated and comprehensive National Program.

LEGISLATION AND ORGANIZATION

The Interagency Task Force on Acid Precipitation was established by the Acid Precipitation Act of 1980 (Title VII of the Energy Security Act - P.L. 96-294) to oversee the planning and implementation of the National Acid Precipitation Assessment Program. The Task Force is jointly chaired by the Environmental Protection Agency (EPA), the Department of Agriculture (USDA), and the National Oceanic and Atmospheric Administration (NOAA). The Council on Environmental Quality serves as the Executive Secretary of the Task Force. The remaining members include one high-level representative from each of the other eight Federal entities in the Program: the Departments of Energy (DOE), Interior (DOI), Commerce (DOC), Health and Human Services (HHS), and State (DOS); the National Aeronautics and Space Administration (NASA); the National Science Foundation (NSF); and the Tennessee Valley Authority (TVA). The Task Force also includes the directors of Argonne, Brookhaven, Oak Ridge and Pacific Northwest National Laboratories, as well as four Presidential appointees.

The Task Force itself functions as the "board of directors" for the National Program by setting the research goals, identifying the projects needed to meet these goals, and deciding which agencies are best suited to conduct the necessary work.

In addition, the primary responsibilities to the Task Force are to:

- Plan and manage the National Acid Precipitation Assessment Program.
- Provide annual reports on the National Program's progress.
- Produce an annual interagency budget for the National Program.
- Coordinate the National Program with the research and monitoring activities of the private sector groups, environmental organizations, states, and other nations.
- Maintain an inventory of Federally-funded acid deposition research projects.
- Disseminate research results, and assessments of their implications.

The Task Force has 10 working-level Task Groups, one for each of the National Program's nine research categories and one for international activities. These technical groups include program managers and experts from all the participating Federal agencies and National Laboratories. They are responsible for the detailed planning and research in their assigned areas. The Task Groups with their Coordinating Agencies are:

Task Group	Coordinating Agency
A. Natural Sources	NOAA
B. Man-made Sources	DOE
C. Atmospheric Processes	NOAA
D. Deposition Monitoring	DOI
E. Aquatic Effects	EPA
F. Terrestrial Effects	USDA
G. Effects on Materials and Cultural Resources	DOI
H. Control Technologies	EPA
I. Assessments and Policy Analysis	EPA
J. International Activities	DOS

The Research Coordination Council (RCC) oversees and integrates the efforts of the various Task Groups, and develops draft reports, program plans, budgets and other recommendations for consideration by the full Task Force. The joint chairs designated the Task Force's executive director to chair this council. The RCC includes leaders of all the Task Groups, the chairperson of the National Laboratory Consortium, and other appropriate agency representatives.

Funding History and Budget Process

The Task Force's efforts in planning and managing the National Program were built upon previous Federal activities. Prior to the passage of the Acid Precipitation Act of 1980, several Federal agencies were sponsoring acid rain research, but more in a piecemeal fashion than a coordinated program. The Acid Rain Coordinating Committee (ARCC), which was established in 1980, was an attempt to organize the ongoing Federal efforts. After the Act passed, the ARCC was reconstituted, and provided the foundation upon which the statutory National Acid Precipitation Assessment Program was established.

In FY 1980, the various Federal "mission" agencies spent or obligated about $11 million on research programs directly related to acid rain; approximately $13 million was spent or obligated in FY 1981. The Task Force developed its first interagency budget for the Program in January, 1981 and submitted it to Congress as part of the President's FY 1982 budget request.

The role of the Task Force in planning the interagency budget for the National Program is a highly effective and unique aspect of the Federal effort. During this interagency budget process, the Task Force receives initial guidance on the target funding levels for the total program; it then advises the individual Task Groups of the anticipated increases (or decreases). Using this as guidance, the Task Groups adjust their research plans or suggest new initiatives, as appropriate, for the target funding levels. The Task Groups present their budget package to the Task Force for review and approval. From this the Task Force develops and submits its interagency budget recommendations; the agency budget requests are thus reviewed as part of an integrated multiagency program.

By working together through the Task Force, the agencies have established a research program that addresses national needs while building on the research expertise of the individual agencies. This strong interagency planning process ensures an integrated and comprehensive program, with each agency contributing to specific aspects of the overall national effort.

The Task Force is vigorously implementing the comprehensive national research program. The history of Federal funding for acid deposition research from FY 1980 to FY 1984 is shown in Figure 1. The interagency budget for the National Program was $17.4 million in FY 1982 (Figure 2), $22.3 million in FY 1983 (Figures 3, 4, & 5), and $27.6 million has been requested for FY 1984 (Figure 6). Federally-funded acid deposition research has doubled from about $11 million in FY 1980 to $22.3 million for FY 1983, and the President's budget for FY 1984 requests a further 24% increase in funding. The National Program is producing results at an increasing rate, and disseminating them as soon as they become available.

Annual Report

By law the Task Force is required to issue an annual report to the President and Congress describing the progress of the National Program. The Task Force's first annual report was issued in January, 1982; with research barely underway, the report discussed primarily the development of the management structure, and the initial implementation of the Program.

In June of this year the National Acid Precipitation Assessment Program issued the FY 1982 annual report to the President and Congress on its first full year of research. The report summarizes the status of scientific knowledge, the major research findings and accomplishments of the National Program's first year, and the outlook for continued progress. As the National Program progresses, future annual reports will provide new findings and increasingly better information to assist decision makers and the public in continuing to resolve the acid rain issue.

NATIONAL PROGRAM MANAGEMENT ACTIVITIES

In addition to internal planning and management activities, the Task Force meets with representatives of key non-Federal groups conducting acid deposition research and monitoring activities. The Task Force is committed to conducting a National Program that coordinates the Federal efforts with the activities of the states, private sector groups, research institutes, environmental groups, and other countries, especially Canada. Several specific steps have been taken to develop and encourage such cooperation and more extensive joint planning activities are anticipated. Such activities include:

National Plan Workshop

Besides a public review of the draft plan of the National Program, the Task Force's April 1981 workshop of non-Federal experts began a dialogue with state and private groups. The workshop report describes the participants' ideas concerning how coordination and cooperation can best be accomplished. The Task Force is implementing many of these suggestions and is actively pursuing continued exchanges of information with non-Federal groups.

Annual Meeting

The Task Force holds an annual meeting for program participants to assess research progress, to propose future work, and to assess the implications of existing information. The meeting provides a mechanism to bring together the full spectrum of research managers and scientists to fascilitate dialogue about the National Program and foster integration of its various elements, and thus enhance program unity.

At the First Annual Review Meeting of the Task Force (September 1982), approximately 30 non-Federal participants provided valuable ideas to discussions on interrelationships among research areas, using the draft technical Operating Research Plan as background. Discussion was focused on the key questions being addressed, as well as the priorities and direction of the research.

The next annual meeting is proposed for January 16-18, 1984 with the theme being "research to meet policy needs". This meeting will be an effort to educate decision makers on the capabilities and the limitations of the National Program's research and assessment activities, as well as a prime opportunity to get feedback on the needs of the decision makers. In addition to members of the Task Force, the invited participants will include senior congressional staff; representatives from states, private sector and environmental organizations; and key scientists.

U.S.-Canadian Research Program Cooperation

In April 1982 and July 1983, Task Force representatives met with the Canadian Federal/Provincial Research and Monitoring Coordinating Committee (RMCC) to expand bilateral scientific cooperation. Leaders of both the U.S. and Canadian research efforts emphasized the mutual value of greater cooperation and coodination of activities. The minutes of the July 1983 meeting include synopses of all bilateral acid deposition research projects currently underway, as well as listings of suggested projects to be undertaken jointly by the two countries in the future. The Task Force representatives feel that much of the suggested research is promising, and the National Program is now using the list of suggested projects in setting its research priorities for the FY 1985 budget process.

Federal-State-Private Sector Coordination

The Task Force initiated and encouraged joint sponsorship of an Acid Deposition Research Coordination Workshop in November 1982. The non-Federal sponsors included the Electric Power Research Institute, the American Petroleum Institute, the Gas Research Institute, the Coordinating Research Council, and the National Council of the Paper Industry for Air and Stream Improvement. Environmental groups and states were also invited to participate.

The purpose of the workshop was to bring together key Federal and non-Federal managers of acid deposition research to review and discuss the management and coordination of their research planning efforts. Specifically, the two goals of the meeting were (1) to assess the scope of the nationwide acid deposition research effort, and (2) to initiate a continuing process for joint planning and coordination of Federal and non-Federal acid deposition research efforts.

In addition to developing joint statements on research needs and disseminating information, the state representatives agreed to organize by regions and to define their specific areas of expertise. The Task Force agreed to investigate ways to increase opportunities for state and private sector participation in reviewing the National Program. Follow-up activities include further discussion between the Task Force, and the private sector and state representatives to work out the details.

Since the workshop, National Program representatives have participated in several meetings with the states to help identify the specific research needs of the region, and to encourage the states to develop research programs on acid deposition. Initial plans have also been made for a follow-up meeting with the original participants and others.

National Program Research Peer Reviews

An integral part of the sound management of the National Program is periodic peer reviews by a panel of outside experts. These detailed scientific reviews allow the National Program's research to be examined in a comprehensive manner rather than as a series of discrete agency projects, and provide the opportunity to assess the quality of the science. More specifically, the reviews are designed to:

- provide an opportunity for National Program researchers to report on progress, and to present research results and major findings;

- facilitate the exchange of information, and enhance cooperative research among scientists involved in the Federal program and others;

- provide an opportunity for those outside the Federal government to review and comment on the evolving National Program; and

- assist research managers in providing adequate program coordination and research direction.

The 25-30 invited reviewers are chosen from the leading scientists in the United States, Canada and other nations. They critically evaluate all the research to ensure that each project contributes to the identified objectives, milestones, and deliverables, and they assess the research progress and plans as well as make recommendations to guide future research.

The review of aquatic and terrestrial effects research was held in February 1983, and the review of sources, monitoring and atmospheric processes research was held in August 1983. The review of assessment activities is proposed for February, 1984.

Inventory of Acid Rain Research Projects

Project descriptors for all the Federally-funded research were entered into the computor this spring, and are presently being verified by each Task Group leader. The inventory includes information on all ongoing projects with the performer(s), duration, funding, study area, research goals, methodologies, and expected outputs. With the Federal research projects on-line, work can begin in FY 1984 on the inventory of all state-sponsored research and monitoring acitvities. The computer inventory will be maintained and updated for use by the Task Force, and all interested parties. The private sector has conducted a similar inventory of its activities; together with the Task Force's effort, this should provide a complete catalog of all acid deposition research and monitoring activities in the United States.

Information Dissemination

The National Program served as the catalyst and hosted a meeting on acid rain information sources in October, 1983. This meeting brought together sponsors, producers and users of bibliographies and research project inventories on acid rain. Presentations were made on the status and outlook for these services, with the focus on the scope and purpose, dissemination and availability, and identification of user needs. The interaction between the participants was encouraging, and greater cooperation is anticipated for the future.

MAJOR RESEARCH QUESTIONS

The National Program includes research, monitoring, and assessment activities to develop answers to major research questions. In addition to identifying and reducing scientific uncertainties, the National Program is organizing the scientific information to address policy questions. The Task Force is establishing a systematic framework for evaluating costs and benefits of alternative policy options for controlling man-made sources of acidity or mitigating adverse effects.

Some of the overall research questions the National Program is specifically addressing are given here with some indication of the type of work underway to answer the questions.

1. **Does acid deposition significantly affect aquatic resources, crops, soils, forests, materials, or human health?** Except for poorly-buffered lakes, evidence on other actual impacts is inconclusive. The National Program includes intensive laboratory and field studies to develop a more definitive understanding of the potential for damage to sensitive resources.

2. **Where are the sensitive resources? How much damage has occurred, or how long will it take for damage to occur?** Concern about acid deposition centers around its potential and known effects. The National Program is developing inventories of the aquatic, terrestrial, and cultural resources at risk, and is surveying the resources that have already been affected by acid deposition.

3. **What is the relative contribution of wet versus dry deposition of acids?** Dry deposition may constitute up to 50 percent or more of acidifying substances, but reliable methods for its routine collection do not yet exist. Vigorous efforts are underway in the National Program to develop appropriate techniques for adequately monitoring dry deposition on a routine basis. In the meantime, interim methods for collecting dry deposition will be used to provide the best currently available data.

4. **What is the relative importance of local versus distant sources in controlling the acidity of deposition at a given location?** Neither models nor measurements currently address this question with a resonable degree of confidence. The National Program includes a broad atmospheric sciences effort with models, experiments, and measurements in the field and laboratory designed to improve our understanding of source/receptor relationships as rapidly as possible. Information on the characteristics and magnitude of man-made emissions is being redefined as well.

5. **What is the relative contribution of man-made versus natural sources of acid-forming materials?** Significant natural sources exist, but their role is uncertain. The amount of natural acid precursors arising from sources such

as oceans and marshes is being determined by the National Program to assess their contribution to acidity over North America. The magnitude, distribution and character of man-made emissions are also being investigated to more accurately identify their contribution to acid deposition.

6. What is the temporal and spatial distribution of acid deposition? Monitoring efforts before 1977 were fragmented and inadequate for determining trends. A National Trends Network with standardization and quality control has been established to answer these questions. Using a variety of information sources, research is also underway to improve monitoring techniques and to decipher any past trends.

7. What changes in deposition would result from a given change in sulfur dioxide, nitrogen oxides, organics, and/or primary sulfate emissions? Scientists cannot precisely calculate the amount of emission reductions that would be required to reduce acid deposition below a particular level within a given area. We need to know more about atmospheric processes to accurately quantify source/receptor relationships. The National Program's assessment activities integrate information on sources and atmospheric processes to address this question.

NATIONAL PROGRAM ACCOMPLISHMENTS

Some selected highlights of progress in the past two years (FY 1982 and 1983) for the National Program's research areas are as follows:

A. Natural Sources

o Delivered the budget survey of natural sulfur and nitrogen emissions required for the transport/transformation modelers of atmospheric processes.

o Developed and tested instruments for reliable field measurement of sulfur and nitrogen emissions from natural sources.

o Continued flux measurements of natural sulfur compounds in the ocean that suggest that emissions from marine sources may contribute significantly to atmospheric acidity in some areas.

B. Man-made Sources

o Completed preliminary study on emissions sources which suggested that nearby petroleum combustion, as well as local and distant coal combustion, could significantly affect local acid deposition.

o Continued development of models to predict the cost and emissions changes from utilities and industries based on various possible control strategies.

- Continued to develop emissions inventories for testing the transport/transformation models with improved spatial, temporal, and source-type resolution, and initiated studies to better characterize the man-made sources of acid precursor pollutants.

C. Atmospheric Processes

- Improved understanding of atmospheric transport, cloud processes and scavenging processes.

- Initiated major field experiment to track the movement of tracer gases released in the Midwest and Canada over hundreds of miles.

- Improved atmospheric models and applied them to gain a better understanding of the movement and conversion of pollutants, and the deposition of acidic material.

- Improved empirical techniques for assessing source/receptor relationships, dry deposition of SOx and NOx gases and particles, and the transport of sulfur and nitrogen across North America.

D. Deposition Monitoring

- Produced the first comprehensive maps describing the distribution of major chemical species over North America.

- Established the National Trends Network for measuring background quantities of wet acid deposition products.

- Developed prototype equipment and procedures for routine monitoring of dry deposition.

- Improved methods for field checks of pH and conductivity on low-concentration solutions.

E. Aquatic Effects

- Produced a nationwide map and regional maps of the Northeast, Southeast, South Central, and Upper Midwest, indicating areas where surface waters are likely to be most sensitive to acidification.

- Began long-term study of causal relationships of acidic effects on biota for twenty sensitive watersheds.

- Completed preliminary survey of drinking water in the Northeast that indicates some reservoirs and their watersheds have limited ability to buffer acid deposition.

- Took lake core sediment samples to examine historical patterns of deposition.

- Improved understanding of factors controlling the susceptibility of surface waters to acidification, and improved methods to quantify, assess, and show trends of acid deposition effects.

- Provided research information for predicting acidification of water bodies, and for assessing potential effects of liming to restore or mitigate acidification damage.

F. Terrestrial Effects

- Reported on the use of models to predict changes in forest growth due to acid deposition.

- Initiated extensive long-term studies to determine whether acid rain has caused changes in rate of growth and species composition in forests; also, reported on assessment of tree ring data for chemically acid environments.

- Screened forest, range and agricultural crops for greater sensitivity to disease, insect damage, and vulnerability to acid deposition.

- Performed studies in the Southeast, mid-Atlantic coast, and Northeast on soil nutrient mobilization factors related to changes in acid deposition.

- Completed several studies showing that forest ecosystems alter the acidity of rain traveling through them.

- Examined importance of dry deposition to increasing acidity throughout the forest canopy, and the response after introduction into the surface waters of the nearby watershed.

G. Effects on Materials and Cultural Resources

- Began work to determine possible acid-deposition-related damage to historical monuments.

- Completed tombstone studies to estimate historical rates of deterioration.

- Installed simple deosition monitoring devices to determine damage to historical and other materials in the urban environment.

- Began analysis of available materials deterioration data and started documenting performance of possible protective treatments for masonry.

- Designed a field survey for delineation of materials at risk across the country.

H. Control Technologies (This hardware development was funded separately in other programs.)

- Tested limestone injection multistage burner system (LIMB) that showed a decrease of 50 percent in sulfur dioxide and nitrogen oxides emissions for retrofitted burners and 70 percent for new facilities.

- Developed burner systems to decrease nitrogen oxides emissions by 75 percent in large coal-fired boilers.

- Assembled data on the characteristics of U.S. coals to aid in determining their emission control potential.

- Evaluated improved wet and dry sulfur dioxide scrubbing (removal) processes.

- Began studies of coal cleaning practices, engineering costs of control technologies, directly emitted acidic materials, integrated control systems, and passive (non-hardware) control systems.

I. Assessments and Policy Analysis

- Prepared the "Critical Assessment Document: The Acidic Deposition Phenomenon and Its Effects" with chapters reviewing acid deposition and its impacts with contributions from 54 scientists from many institutions in this country and abroad. The document is now undergoing final revision.

- Prepared advanced methods for integrated assessment linking all components of transport within and exchanges among relevant systems and receptors, over time and space.

- Developed analytical and statistical frameworks for increasingly complex modeling assessments, including cost-benefit comparisons.

- Developed the preliminary version of a model for assessing sulfur dioxide emissions from the utility sector, and developed empirical assessment techniques for use until reliable models of source/receptor predictions are delivered.

- Began investigation of estimating uncertainty in models and the implications for formulating control strategies.

J. International Activities

- Continued to cooperate with Canadian counterparts for joint research proposals.

- Published "International Directory of Acid Rain Researchers", listing 1,000 scientists in 32 countries.

- Continued to compile international research information on acid deposition activities worldwide.

More details of these and other recent accomplishments in the various research categories will be contained in the FY 1983 Annual Report of the National Acid Precipitation Assessment Program.

OUTLOOK FOR RESEARCH: FY 1985 to 1989

In the next several years the research under the National Program will produce a number of important results. The following are some highlights of specific accomplishments the National Program can produce by FY 1989.

A. Natural Sources

o Develop an experimental data base that characterizes the natural emissions of sulfur, nitrogen, chlorine, and alkaline emissions (ammonia and others) on both a national/global and regional scale.

B. Man-made Sources

o Update the emissions inventory to an FY 1984 base year.

o Add hydrogen fluoride, hydrochloric acid, ammonia and other alkaline substances to the inventory. Also add volatile organic compounds (VOC) by reactivity class, and disaggregate amounts of sulfur and nitrogen compounds as necessary.

o Refine, test, and operate the man-made emissions model for the 1987 and 1989 Assessments.

C. Atmospheric Processes

o Provide a definitive mass balance for compounds of sulfur and nitrogen in North America.

o Provide a model capable of assessing localized (mesoscale) rates of wet and dry deposition from nearby sources, and develop an advanced model capable of improving assessment methods.

o Develop techniques for measuring dry deposition products that contribute to acidification.

o Conduct a major air transport experiment to help define long-range patterns of distribution and rates of atmospheric conversion to acidifying substances, for example, conversion patterns of SO_2 and SO_4 downwind of major industrial areas.

o Conduct basic research on cloud processes that affect formation of acidifying substances.

D. Deposition Monitoring

o Addition of dry deposition monitoring into the National Trends Network (NTN) protocol, as well as trace metals and select organic substances.

o Expansion of the NTN and Global Trends Network to provide more reliable patterns of acid deposition.

E. Aquatic Effects

- Develop recommendations for liming acidified water bodies.

- Develop and validate biological response models assessing effects of acidification over a range of loading rates and terrestrial conditions.

- Report on health effects, fish populations at risk, drinking water responses, and waterfowl effects as these relate to acid deposition.

F. Terrestrial Effects

- Update reports on acid deposition effects on soils, especially soil-nutrient changes, and mobilization of aluminum and other metals; also, forest species effects; and responses of soybeans, corn and other crops.

- Complete a series of experiments and effects determinations to examine the enhanced susceptibility of agricultural and forest crops to disease and reduced yields.

G. Effects on Materials and Cultural Resources

- Provide damage functions with acceptable levels of confidence for materials exposure to SOx, NOx and ammonia.

- Recommend protection methods for materials at risk as an alternative to stringent controls.

- Complete materials inventories for the United States.

H. Control Technologies

- Report on control of directly emitted acidic materials, control of volatile organic compounds, industrial process controls, and state-of-the-art reports on control technologies.

- Evaluate passive (non-hardware) control strategies, and combinations of low cost control options, such as limestone injection multistage burner system (LIMB) and load dispatching, to attain goals.

I. Assessments and Policy Analysis

- Develop sophisticated source/receptor assessment models, combining control and effects mitigation to integrate overall National Program modelling inputs.

- Devise and perfect decision analysis methods combining cost and benefit data for effectively managing acid deposition.

- Devise optimal scientifically-sound strategies for managing national acid deposition control programs.

J. International Activities

- Continue and expand the cooperation with foreign countries and international resources of acid deposition research.

The National Acid Precipitation Assessment Program made an ambitious start and broad progress during its first two years of research (FY 1982 and 1983). It will take a systematic effort over a number of years to adequately address the major uncertainties about the causes, effects, and management of acid deposition. The Program has laid the groundwork for continued scientific advancement, and a framework has been established to focus the research on answering the questions most critical for developing sound policies. The National Program's recurring assessments will provide a successively refined scientific basis for decision making, and the opportunity to reexamine research directions throughout the 1980's.

Figure 1

FEDERAL
ACID DEPOSITION RESEARCH
FUNDING HISTORY

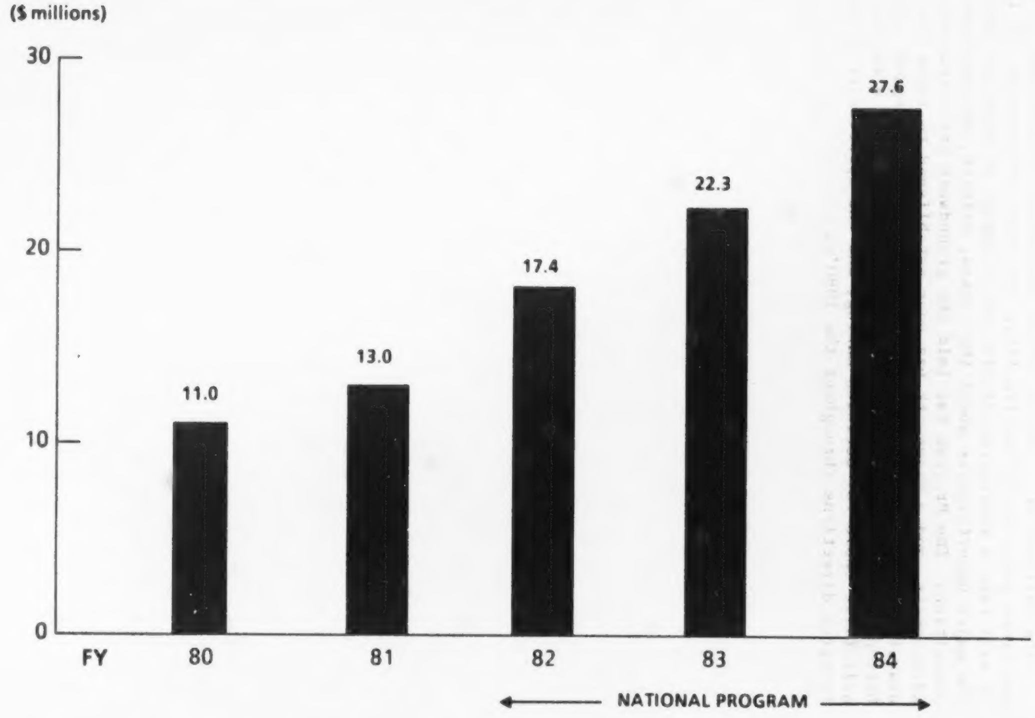

Figure 2

NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM

ACTUAL EXPENDITURES
FY 1982
($ in thousands)

		DOA				DOI				
	EPA	SE	FS	NOAA	DOE	PS	GS	FW	TVA	TOTAL
A. Natural Sources				600						$ 600
B. Man-made Sources	870				300					1170
C. Atmospheric Processes	3273			600	805	50			126	4854
D. Deposition Monitoring	797	253	127	700	497	75	585			3034
E. Aquatic Effects	1475		135		560	94	580	75	133	3052
F. Terrestrial Effects	1355	264	570		122	178	295		65	2850
G. Effects on Materials	250					178				428
H. Control Technologies	(10,400)*				(6200)*					(16,600)*
I. Assessments and Policy Analysis	1105				260					1365
Subtotals:		517	832			575	1460	75		
TOTALS:	$ 9125	1349		1900	2544		2110		325	$ 17,353

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* Control Technologies figures not included in total. These funds for general development of SO_2 and NO_x control hardware are appropriated under other preexisting programs. The Control Technologies Task Group coordinates these efforts with the assessment and research activities of the National Program.

Figure 3

NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM

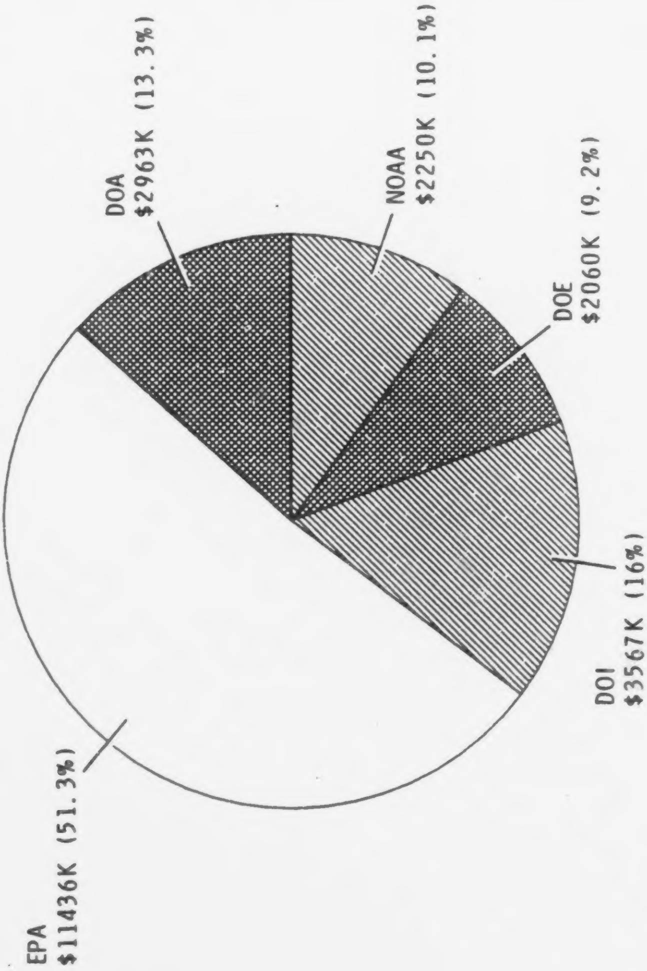
FY 1983
($ in thousands)

		DOA				DOI			
	EPA	SE	FS	NOAA	DOE	PS	GS	FW	TOTAL
A. Natural Sources				700					$ 700
B. Man-made Sources	1050				300				1350
C. Atmospheric Processes	3858			1050	274	50			5232
D. Deposition Monitoring	1145	404	145	500	666	100	1449		4409
E. Aquatic Effects	1935		210		550	148	445	75	3363
F. Terrestrial Effects	1468	946	1258		50	229	486		4437
G. Effects on Materials	410					535	50		995
H. Control Technologies	(7600)*				(6500)*				(14,100)*
I. Assessments and Policy Analysis	1570				220				1790
Subtotals:		1350	1613			1062	2430	75	
TOTALS:	$ 11,436	2963		2250	2060		3567		$ 22,276

* Control Technologies figures not included in total. These funds for general development of SO$_2$ and NO$_x$ control hardware are appropriated under other preexisting programs. The Control Technologies Task Group coordinates these efforts with the assessment and research activities of the National Program.

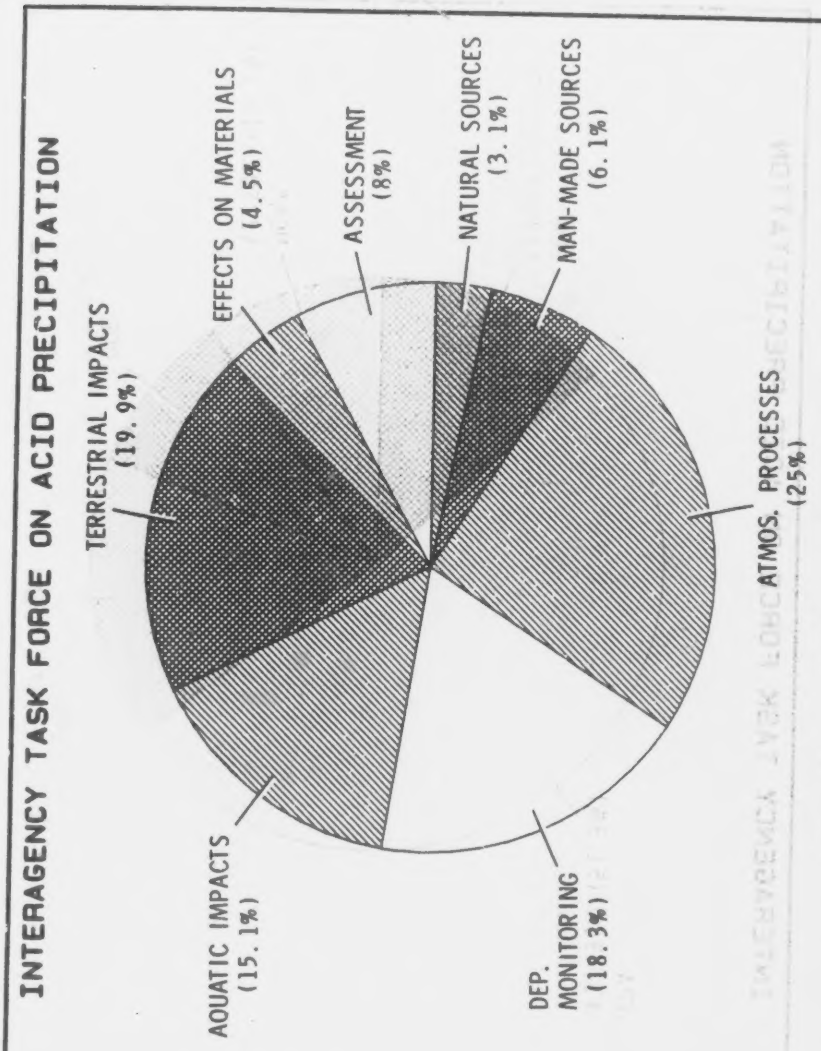
Figure 4

INTERAGENCY TASK FORCE ON ACID PRECIPITATION



Fiscal year 1983 funding by agency.

Figure 5



Fiscal year 1983 funding by research category.

Figure 6

NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM

Proposed revisions to the President's Budget Request (May 1983)

FY 1984
($ in thousands)

		DOA				DOI				
	EPA	SE	FS	NOAA	DOE	PS	GS	FW	BLM	TOTAL
A. Natural Sources				955						$ 955
B. Man-made Sources	1090				260					1350
C. Atmospheric Processes	5250			1020	270					6540
D. Deposition Monitoring	1789	274	146	1130	942	122	1870		80	6353
E. Aquatic Effects	2285		210		550	148	445	125		3763
F. Terrestrial Effects	1468	946	1258		50	229	486			4437
G. Effects on Materials	605					740	150			1495
H. Control Technologies	(4100) *				(7000) *					(11,100) *
I. Assessments and Policy Analysis	1500				1175					2675
Subtotals:		1220	1614			1239	2951	125	80	
TOTALS:	$ 13,987	2834		3105	3247	4395				$ 27,568

* Control Technolgies figures are not included in totals. These funds for general development of SO_2 and NO_x control hardware are appropriated under other pre-existing programs. The Control Technologies Task Group coordinates these efforts with the research and assessment activities of the National Program.

NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM
722 JACKSON PLACE, N.W.
WASHINGTON, D.C. 20506
202/395-5773

November 21, 1983

Ms. Heather Wicke
Committee on Environment
and Public Works
Subcommittee on Toxic Substances
and Environmental Oversight
Dirksen Senate Office Building
Washington, DC 20510

Dear Heather,

Enclosed are the written responses to the six questions posed by Senator Durenberger and Senator Baucus. I have tried to address each question adequately, but I realize that some of my answers to the policy-related questions may be less than satisfying. As I discussed with you before testifying, I can provide objective scientific information but I am not the appropriate spokesperson for Administration regulatory policy.

Thank you for the opportunity to testify. Please don't hesitate to contact me if I can be of further assistance.

Sincerely,

Chris Bernabo

Chris Bernabo
Executive Director

Response to written questions from Senator Durenberger

by Dr. Chris Bernabo, Executive Director
National Acid Precipitation Assessment Program

November 21, 1983

1. Over the past three years of planning and implementing the National Acid Precipitation Assessment Program, there has been a very high degree of cooperation among the federal agencies. The various agencies have developed a coordinated federal-wide program to address this important national issue. While such close cooperation could occur without being legislatively imposed, the statutory mandate helps ensure that it will be done and that it is maintained even as administrators and administrations change. Legislation such as the Acid Precipitation Act of 1980 (P.L. 96-294) is essential for addressing complex issues in which many agencies must participate.

The cooperation among the agencies takes many forms under the National Program, such as integrated planning and peer review, joint funding of projects, and the development of a single interagency budget for the program. The interagency budget process is especially important because it helps avoid both unnecessary duplication and crucial gaps in the overall effort. By having the identity as a National Program, we can tackle complex problems in a comprehensive manner, rather than the typically more parochial and piecemeal approach that can result with many individual agency efforts.

2. The interagency process of the National Program has definitely helped maintain the objectivity and thoroughness of the federal research effort. In jointly developing national program goals, planning research and summarizing results, all the agencies must work to reach consensus. The outcome, if not the ease, of this process is aided by the diversity of strengths and perspectives that the different federal entities provide.

There is a great benefit in cooperatively establishing a scientific information base, even though individual agencies may still differ on the policy implications of that information. For very complex and highly controversial issues like acid rain, a broad-based cooperative effort is essential for the success and credibility of the research. In addition, the federal program must also effectively be coordinated with the states, private sector, and international efforts, and we have put increased emphasis on building these linkages.

The National Program is explicitly designed to provide a successively improved information base for decision making. To date we have not made any policy statements on acid rain, but we have recommended research directions, as well as described the status and significance of current scientific understanding of the problem and its potential solutions. Objective scientific information is only one necessary ingredient to any policy recommendation on acid rain. When the science still contains many key uncertainties, the role of subjective value judgments and political considerations becomes far greater in determining policy.

The National Program is not well-suited to making independent recommendations because it is a creature of the Executive Branch. Any policy we recommend would have to be cleared by all the agencies, and this could only reflect the position of the incumbent administration. We have made extensive efforts, using external peer reviews and open discussions, to ensure that an objective and comprehensive federal research program is being carried out. Attempting subjective recommendations might bring into question the credibility of our research, which must be policy-neutral if it is truly to help the polarized national debate.

3. As you state, information must be adequately organized and readily available to assist decision making. Maintaining a computerized inventory of research is one key way of helping ensure that the information is accessible. I think such inventories are crucial tools for maximizing the return on our nation's investment in research.

Response to written questions from Senator Baucus
by Dr. Chris Bernabo, Executive Director
National Acid Precipitation Assessment Program
November 21, 1983

1. It will take a sustained research effort over many years to answer the key scientific uncertainties about acid rain. In recent years, the political debate and public concern have moved ahead far more rapidly than has our scientific understanding. At this point, we simply do not have adequate scientific tools to design an optimal control strategy with a high degree of confidence in our success. For instance, scientists generally agree that the relative importance of local versus distant sources is not yet known. Any specific acid rain control strategy developed now of necessity would be based as much on subjective economic and political considerations as on any firm scientific basis.

   While our lack of scientific understanding is distressing, clearly the uncertainty alone does not preclude action. Decision makers often must act in the face of great uncertainties, particularly with environmental issues like acid rain. The dilemma is that existing scientific information clearly indicates a need for concern, but is much more ambiguous on what the full scope of the problem is and what the most effective solutions will be. Unsatisfying as that may be, this is why research is urgently needed to address the problem more adequately. Acid rain is a long-term problem unlikely to have any short-term solution. In the near term Congress and the Administration must assess the scientific uncertainties and make the hard value judgments and political calls necessary to formulate policy. Any responsible approach to the problem should be flexible enough to allow for changes in future years as new information becomes available.

2. From a scientific standpoint, many major questions remain about acid deposition. For instance, the rate at which aquatic changes are taking place is uncertain, and the actual extent of such damages is only now being rigorously documented. The relationship between pollution sources and sensitive receptors is poorly understood and the degree to which forests, crops, building materials and human health are threatened by acid deposition is not well-established.

   The National Program has set in motion an ambitious effort to reduce the scientific uncertainties and successively improve the information base necessary to develop effective solutions to the problem. Our strategy is to build on existing information and target our research on the areas of uncertainty most relevant to decision making. In the early years of the program we are conducting nationwide surveys to determine the extent and location of sensitive resources and the current impacts. As described in our 1982 Annual Report, a nationwide mapping of sensitive surface waters has been completed. Similar surveys of terrestrial and material resources, and an assessment of drinking water supplies are ongoing.

In addition to determining the extent of the problem, we are initiating research to improve our understanding of the processes and enhance our ability to predict changes. Major research is underway to develop a better capability to model the movement of pollutants and the deposition of acids. With field and laboratory studies we are examing the potential impacts on forests, crops, and materials.

The details of the National Program are described in our 1982 Annual Report and other documents. The first eight pages of the enclosed Annual Report provide an overview of the science, research progress and planned research.

3. The EPA budget for FY 1984 contained a line item for 5 million dollars to initiate a full-scale demonstration of the LIMB technology, which is to be co-funded by an industrial partner(s). The agency has formulated a plan for that demonstration. The plan was reviewed with an industry panel consisting of 18 representatives of the full range of private sector organizations with interests in the technology. The plan received favorable review by the panel and is currently being implemented. It includes expanded and accelerated research and development to support the full-scale demonstration design.

The demonstration will be carried out on a 200-250 MW wall-fired utility boiler. The contract will be awarded on a competitive basis and will require at least 50% private sector co-funding. While the EPA will monitor the contract, the work will be performed by a team consisting of a utility company, a boiler manufacturer and/or equipment vendor(s).

There has been widespread industry interest in participating in the EPA's co-funded demonstration. All indications have been that any industry decision for a full-scale LIMB demonstration in the U.S. will be contingent on such co-funding. The EPA's R&D program is the major effort of that type and will be essential to the success of the technology.

The technology development for one of the major classes of wall-fired boilers will be sufficiently advanced to allow final design by mid-1985. Development for the other major class of boiler (tangentially-fired) is scheduled for two years later, dependent on funding. The co-funded demonstration which is targeted for wall-fired boilers will be completed by late 1987. No funding for an EPA tangential boiler demonstration is provided at this time. Application of the technology by industry will be determined by their confidence in the generality of the technology and could commence as early as 1988. The confidence would be greatly expanded by additional demonstrations, particularly for a tangential boiler.

The U.S. program has worked closely with its European counterparts in this area for a number of years. In general, because of differences in equipment design and/or fuels fired, the European experience is not directly applicable to U.S. boilers. There are, however, a number of areas in which information exchange has been and will continue to be valuable. As a part of that exchange, the EPA is negotiating a contract to participate in the evaluation of a sorbent injection system on a 700 MW low-sulfur boiler in the Federal Republic of Germany. That effort is being conducted by L&C Steinmuller with funding from the Umweltbundesamt, the FRG environmental agency.

Statement of Charles W. Edington
Office of Energy Research
Department of Energy
Senate Environment and Public Works Committee
Subcommittee on Toxic Substances and Environmental Oversight
October 17, 1983

Mr. Chairman and Members of the Subcommittee:

I am pleased to appear before you today to provide an overview of the Department's environmental research and development programs, and to highlight current research priorities. The Office of Energy Research's (ER) Biological and Environmental Research (BER) program carries the dominant responsibility for environmental research and development within the Department. In addition, ER is responsible for research that addresses the carbon dioxide issue. The Department's Office of Fossil Energy supports basic and applied R&D that is designed to improve control technology for reducing emissions and effluents. I will summarize the key research activities in each of these research areas.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH

The BER program managed by the Office of Health and Environmental Research originated with the establishment of the Atomic Energy Commission and for its first quarter century addressed health and environmental issues associated with the Nation's nuclear defense and nuclear energy technology activities. With the expanded legislative responsibilities mandated by its incorporation into the Energy Research and Development Administration and subsequently the Department of Energy, the scope of the research program was broadened to encompass health and environmental research related to non-nuclear energy technology development.

Background

The BER research program, with an FY 1984 budget of $182.0 million, is comprehensive in scope and includes basic research into the normal functioning of biological and ecological systems as well as focused research to investigate health and environmental effects that may be related to energy technology development and use.

The BER program is the only long-term, multidisciplinary research effort in the Federal Government specifically devoted to the range of environmental and health issues that we are likely to face in expanding existing energy technologies, or developing new energy sources. The goals of this research are to identify, before a technology is locked into place, the early and delayed effects, if any, on human health and the environment. Answers to these questions, if obtained early enough, will permit energy requirements to be met with minimum damage to human health and the environment. In addition, these answers will prevent the expenses associated with unnecessarily restrictive regulations and delays in deploying the technology.

To attain these goals, a number of interdependent research objectives are addressed. These biological and environmental research objectives are: to determine the physical and chemical nature of energy-related emissions, effluents, products and by-product materials; to identify those agents which are potentially toxic to living organisms; to describe their movement, chemical evolution and fate in the environment; and to understand quantitatively their effects on living organisms including humans. The program ranges from research into the fundamental processes governing radiation and chemical interaction in biological systems to research on the dose-effect relationship for differing exposure conditions. Thus, information is continuously being developed on acute and chronic biological effects to assure that realistic and appropriate health and environmental protection procedures are established as technology develops.

BER Research Priorities

A major component of the program is our radiation research effort which currently comprises over 70 percent of the Federal program for radiation research. This is long term research including epidemiology, experimental animal studies, and cellular and molecular investigations with the common objective of defining the biological response to low level radiation exposure.

Extrapolated estimates of low dose biological response from high dose experimental data are generally believed to overestimate the effect because biological repair and recovery processes known to occur at low dose exposures are not considered. Nevertheless, uncertainty remains in our understanding of low dose biological response. Our research is attempting to reduce this uncertainty so that low dose radiation effects can be understood and predicted with greater confidence. This program is coordinated with other agency activities through the Interagency Radiation Research Committee.

Another major component of our BER program relates to fossil energy technology development. The primary thrust is on health and environmental effects research associated with synthetic fuels technologies. We have recently completed an extensive short term research effort designed to determine the biological response that may result from exposure to synfuel materials. The strategy adopted is commonly called "biodirected chemical characterization" and was developed specifically to evaluate biological activity in complex mixtures such as synthetic fuels. This characterization strategy involves a combination of chemical separation procedures in connection with short term bioassays. Through an iterative process of biotesting, chemical separation and analysis, the biologically active material in complex mixtures can be isolated and identified in an efficient manner. The final step, then, is the validation of short-term data in subsequent animal studies.

As a consequence of this early emphasis on relatively short-term studies, this research has established a very substantial data base related to synthetic fuels derived from coal and oil shale. One of the most striking findings from this accumulated data base has been the fact that those materials responsible for biological activity in coal synfuels are essentially the same, regardless of how the synthetic fuels were produced. Thus, long-term research can now address health and environmental issues related to synthetic fuels on a generic basis, rather than a process by process basis.

This short-term data base related to synfuels was essentially completed in FY 1982. In order to establish priorities for the long-term health and environmental issues related to synfuels, BER commissioned several analyses. These analyses summarized the available data on coal gasification, coal liquefaction, and solid wastes from coal conversion technologies; evaluated this data base, and made recommendations for future long-term generic research related to synthetic fuels. In addition, they were used as the basic working documents for a meeting in which all key investigators involved in the OHER program discussed, in open forum, the long-term health and environmental research directions for the synthetic fuels health and environmental research program. These analyses, as well as a report on the findings, have been published and widely disseminated. This documentation has been extensively utilized by BER as a basis for redirection of its health and environmental research programs in synthetic fuels.

Another fossil energy related research activity is our Acid Rain program. The Department's approximately $3 million program in FY 1984 comprises almost ten percent of the Federal activity in this area and involves research on source-receptor relationships including wet and dry deposition, atmospheric chemistry, and development and validation of long range transport models.

We are also undertaking research directed at the evaluation of health issues associated with increased public exposures to indoor air pollutants which result, in part, from energy conservation measures. This program directly supports the U.S. national energy policy that encourages improved energy efficiency and provides guidance on appropriate technological developments that will control these exposures in a cost-effective manner. Primary emphasis of this program has been the investigation of natural radon sources (e.g., soil, building materials) and pathways into structures, and the effect of environmental conditions and indoor-outdoor exchange rates on radon exposure. This program has been coordinated with related work supported by other agencies through the Interagency Research Group on Indoor Air Quality as well as periodic workshops.

Interagency Cooperation

I understand the committee is interested in the interagency coordinating mechanisms that are in place. Earlier I mentioned three such committees that have provided an important forum for program coordination: the Interagency Radiation Research Committee, the Interagency Task Force on Acid Precipitation, and the Interagency Research Group on Indoor Air Quality. There are a large number of other interagency committees and working groups on which our staff serve as participants. A list is attached to my testimony; I think it conveys the scope of interagency coordination that is carried out by the BER research program.

In addition to these interagency activities which provide a vehicle for mutual program planning and coordination, a number of cooperative research activities are in place. For example, the Department and the National Institutes of Health jointly support unique research facilities such as the Scanning Transmission Electron Microscopy Center at Brookhaven National Laboratory and the Flow Cytometry Research Resource at Los Alamos National Laboratory. These facilities are used for fundamental research on the functioning of cells and their constituents such as chromosomes. The Department also supports research aimed at demonstrating the feasibility of new diagnostic or therapeutic methods employing radiation or radioisotopes; the National Cancer Institute then assumes responsibility for comprehensive patient trials to evaluate clinical efficacy. Furthermore, the BER program employs a multidisciplinary "team" of individuals in specialized facilities that have come to be regarded as national resources for research in the biomedical and environmental area. For example, in FY 1982 other agencies invested over $90,000,000 in DOE facilities to conduct "work-for-others" for resolving their research needs.

The results of this research are widely disseminated. Scientists supported by the BER program make more than 2,500 presentations each year at technical meetings, and document their work in books and more than 3000 peer-reviewed open literature journal articles.

In addition, research findings from the BER program are utilized extensively by a number of national and international organizations. These include the National Council on Radiation Protection and Measurements, the International Commission on Radiological Protection and the United Nations Scientific Committee on the Effects of Atomic Radiation. For example, the International Commission on Radiological Protection recently issued Publication 30 on Limits for Intakes of Radionuclides by Workers. This seven volume publication provides international guidance on occupational exposure for over 700 radionuclides.

CARBON DIOXIDE RESEARCH

In 1977, the Department of Energy and several other interested Federal agencies began a concerted effort to define the carbon dioxide issue. The DOE, as the lead Federal agency for carbon dioxide and climate effects research, coordinates these efforts through the National Climate Program Office, established within the National Oceanic and Atmospheric Administration by the National Climate Program Act (P.L. 95-367). The interagency planning, budgeting and review of research is handled through the National Climate Policy Board. Other Federal agencies involved in CO_2 research include the National Science Foundation, Department of Agriculture, National Aeronautic and Space Administration, Department of State, U.S. Geological Survey, Environmental Protection Agency and National Bureau of Standards.

It is the DOE position that current emphasis be placed on improving our understanding of the global carbon cycle, the role of CO_2 in climate perturbation and the cause-effect relationships of CO_2-climate and vegetation effects. Research priorities and areas of interest will change as knowledge increases. It is DOE's plan to emphasize research that will reduce the various scientific uncertainties and unknowns associated with the CO_2 issue. Carbon dioxide research has been budgeted at $12,500,000 in FY 1984, a $3,500,000 increase over the FY 83 budget.

DOE intends to issue in 1985 the first major report delineating what is known, unknown and uncertain regarding CO_2. Prior to that time, individual reports will be released as research data becomes available. The 1985 report is expected to provide a comprehensive state-of-knowledge discussion of the potential long-term implications of CO_2 rather than definitive recommendations pertaining to amelioration policies and strategies. Improved models, data and more definitive analyses for decisionmaking are expected to be available in the early 1990's.

ENVIRONMENTAL TECHNOLOGY R&D

A major object of the Department's Office of Fossil Energy is to support a wide range of basic and applied R&D programs designed to assist industrial and utility companies in developing technologies that could burn high-sulfur coal without degrading the environment.

To meet this general objective, the Fossil Energy program focuses on three points in coal's "fuel chain" where potential pollutants can be removed: (1) prior to combustion in coal cleaning facilities; (2) at the stack, following combustion; and (3) in the combustor or boiler itself, using new concepts of coal combustion.

Prior to combustion: The DOE program is working to develop a sequence of advanced coal cleaning steps capable of removing up to 90 percent of the sulfur and 95 percent of the ash in high-sulfur coal, levels low enough so that coal could replace oil or natural gas in both new and existing applications. To achieve this quality, coal will most likely require much finer grinding than is common today, in some cases to particles roughly 1/1000th of an inch in diameter (finer than those in talcum powder). The

Fossil Energy program is studying various approaches, including the use of high-frequency ultrasonic devices, to achieve this size reduction without expending large amounts of energy.

Removal of ash and sulfur from coal prior to combustion can take one of two principal process routes: physical coal cleaning or chemical coal cleaning. Conventional physical coal cleaning, which relies on physical properties such as density, surface characteristics, and magnetic susceptibilities, can reduce the emissions of sulfur dioxide by 33-50 percent. The Department's research program is funding research on improved versions of physical techniques that could improve the reduction level to the range of 60 to 65 percent.

For most U.S. coals, physical cleaning alone will be unable to produce a compliance coal capable of meeting the NSPS standards (although it might enable older plants in many locales to meet emission standards). To achieve the 90 percent total sulfur reduction level, organic sulfur (sulfur chemically bound to the coal) must also be removed. Chemical cleaning methods being developed with DOE funding either displace sulfur with basic alkali metals, such as sodium, calcium or potassium, or they oxidize the sulfur. Two alkali displacement concepts being pursued by the Department are the TRW Gravimelt process and the GE Microwave process. Both appear capable of producing a low sulfur, low ash, high-Btu coal product that can meet the current NSPS for SO_2 emissions.

The Department is also funding research on a longer-range approach that would employ microbiological techniques to desulfurize coal.

At the stack: The Department's flue gas cleanup program seeks to develop techniques for simultaneously removing sulfur dioxide, nitrogen oxides, and in some cases, particles from the flue gas of coal combusion. For example, the Fossil Energy program is funding research on techniques that beam electrons through combustion gases that have been treated with either an ammoniacal or aqueous mixture of lime, depending upon the process. The electrons cause a complex series of chemical reactions to take place in which the sulfur and nitrogen oxides are converted to dry materials that can be removed by conventional techniques. Another concept being tested at the Department's Pittsburgh Energy Technology Center uses copper oxide to remove sulfur dioxides at temperatures which are suitable for simultaneous nitrogen oxide removal by a reaction with ammonia. While these advanced flue gas cleanup concepts will be capable of reducing sulfur dioxide emissions by 90 to 95 percent, comparable to conventional limestone scrubbers, they also could reduce nitrogen oxide emissions by a similar 90 to 95 percent. Conventional scrubbers typically capture only 10 to 20 percent of the nitrogen oxides. The advanced systems also produce dry products which are much easier to dispose of (and may have commercial value) compared with the wet sludge produced by conventional wet scrubbers.

In the combustor or boiler: The principal research effort in this area involves the fluidized bed combustion (FBC) technique, a method which burns coal in a bed of limestone suspended by upward blowing jets of air. The limestone, chemically changed to lime inside the boiler, absorbs the sulfur dioxide, preventing it from leaving the boiler. The combustion temperatures are also low enough to minimize the formation of nitrogen oxides.

Today, based on cooperative government-industry development efforts, the atmospheric version of the fluidized bed combustion concept is commercially available at industrial scales. The electric power industry is also funding the development of utility-scale atmospheric FBC. The Department's program, therefore, is concentrating its R&D efforts on more innovative fluidized bed concepts having the potential to make coal competitive in small industrial boilers where oil or gas is now more economical, and on the pressurized version which may have potential application in future combined cycle power plants.

The FY 1984 budget request to Congress for the Fossil Energy program includes $5.0 million for the coal preparation program, $7.6 million for the flue gas cleanup program, and $4.4 million for both the atmospheric and pressurized fluidized bed combustion programs.

In addition to these efforts, the Department's Fossil Energy office is conducting research on a wide range of alternative coal utilization technologies that could offer substantial environmental benefits in addition to increasing the applicability of coal as an energy producer. Included is work related to coal gasification/combined cycle power generation, fuel cells, coal liquefaction, and alternative fuel utilization (e.g., coal-slurry combustion).

The DOE activities in this area are complementary to the EPA program in that our research is primarily long term in nature whereas the EPA perspective is near term in support of their regulatory responsibilities. The DOE and EPA activities are closely coordinated through periodic exchanges of information on program plans and programs. In addition there is extensive coordination with EPA through participation on the Man-made Sources and Control Technology task groups of the Interagency Task Force on Acid Precipitation.

Per the Committee's request, I am attaching two budget tables that summarize the environmental R&D activities of the Department's Offices of Energy Research and Fossil Energy.

Mr. Chairman, that concludes my testimony. I would be pleased to answer any questions at this time.

Interagency Committees With OHER Participation

- Council on Environmental Quality (CEQ)
  - Federal Committee on Experimental Ecological Reserves (NSF)
- Department of Health and Human Services (HHS)
  - Committee to Coordinate Environmental and Related Programs (CCERP)
  - CCERP Subcommittee on Environmental Mutagens
- Department of Interior
  - Oil Shale Environmental Advisory Panel
  - Endangered Species Liaison
  - National Committee for Scientific Hydrology
- Department of Navy
  - Federal Oceanographic Fleet Coordination Council
- Department of State
  - Panel on International Programs and International Cooperation in the Oceans
  - Interagency Arctic Policy Group
  - National Committee for Man and the Biosphere
  - Organization of Economic Cooperation and Development (OECD) - Workgroups on Existing Chemicals and Toxicology Testing Guidelines
- Environmental Protection Agency (EPA
  - Interagency Task Force for Acid Precipitation
  - Interagency Working Group on Health Risk Analysis
  - Environmental Health Advisory Committee
  - Interagency Research Group on Indoor Air Quality
  - Task Group on Environmental Cancer, Heart and Lung Disease
- National Academy of Science/National Research Council
  - Ocean Sciences Board
  - Geological Science Board
  - Polar Research Board
  - Water Sciences and Technology Board
- National Cancer Institute (NCI)
  - National Cancer Advisory Board
  - Interagency Collaborative Group on Environmental Carcinogenesis
- National Council on Radiation Protection and Measurement

- National Heart, Lung, and Blood Institute (NHLBI)

  Interagency Technical Committee on Heart, Blood Vessel, Lung, and Blood Diseases and Blood Resources
  Working Group on Cardiovascular Biomedical Engineering

- National Institute on Child Health and Human Development (NICHHD)

  Council of the National Institute on Child Health and Human Development (NIH)
  Interagency Committee on Population Research

- National Institute of Environmental Health Sciences (NIEHS)

  Interagency Committee for Coordination of Toxicological Research

- National Institute of Health (NIH)

  Federal Coordinating Council for Science, Engineering and Technology-Committee on Health and Medicine
  Advisory Committee on Recombinant DNA (NIAID)
  Interagency Radiation Research Committee

- National Oceanographic and Atmospheric Administration (NOAA)

  Ocean Pollution Data Information Network
  Committee on National Atmospheric Research and Development
  Federal Coordinating Committee for Meteorological Services and Supporting Research
  National Advisory Committee on Oceans and Atmosphere
  Committee on Ocean Pollution Research, Development, and Monitoring
  Climate Data Management Working Group

- National Science Foundation (NSF)

  Arctic Research Working Group
  Interagency Atomic and Molecular Physics Coordinating Group
  Technology Assessment and Risk Analysis Panel
  University National Oceanographic Laboratory Systems
  Water Sciences and Technology Board

Office of Energy Research
Environmental R&D Activities
(B/A in Millions)

Biological and Environmental Research	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84
Operating Expenses						
Human Health Research	26.4	27.6	23.4	25.8	25.1	25.2
Health Effects Research in Biological Systems	62.3	65.7	64.6	67.4	56.7	56.7
Environmental Research	35.1	35.9	30.8	29.2	25.3	24.3
Physical and Technological Research	34.6	37.5	36.0	36.1	29.1	28.2
Carbon Dioxide Research	3.1	6.2	9.8	12.0	9.1	12.5
Health & Environmental Risk Analysis	1.0	1.4	4.0	4.0	1.8	1.8
Nuclear Medicine Applications	16.4	17.6	17.4	19.0	18.5	21.0
Program Direction	0	0	3.1	2.8	3.3	3.6
Total Operating Expenses	178.9	191.9	189.1	196.3	168.9	173.3
Capital Equipment	12.7	13.4	13.6	11.7	11.7	7.7
Construction	8.0	6.0	6.4	4.0	2.0	1.0
Total	$199.6	$211.3	$209.1	$212.0	$182.6	$182.0

Office of Fossil Energy
Environmental Technology R&D
(BA in millions)

	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84 Request
Control Technology & Coal Preparation						
Coal Preparation Operating Expenses	9.6[1/]	10.9	7.0	2.9	8.0	5.0
Flue Gas Cleaning Operating Expenses	2.7	20.0	15.0	6.2	7.0	7.6
Combustion Systems						
Atmospheric Fluidized Bed Combustion Operating Expenses	23.6	25.9	11.4	0.3[2/]	4.9	1.0
Pressurized Fluidized Bed Combustion Operating Expenses	14.2	15.0	21.4	25.0	12.5	3.4

1/ Does not include a prior year deobligation of 7.5 M.

2/ Includes an offset of -10.5 M.

POST-HEARING QUESTIONS AND ANSWERS

Relating to

OCTOBER 17, 1983 HEARING
Before the
SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
WITNESS: DR. CHARLES EDINGTON
ASSOCIATE DIRECTOR, OFFICE OF HEALTH AND ENVIRONMENTAL RESEARCH
OFFICE OF ENERGY RESEARCH
DEPARTMENT OF ENERGY

QUESTIONS FROM SENATOR DURENBERGER

Q. 1. The Administration has stressed private sector responsibility for control technology research. To what extent is private industry interested in and directly involved with the long-term efforts of the Department to develop technologies for coal preparation, flue gas cleanup and atmospheric and pressurized fluidized bed combustion programs to reduce sulfur emissions?

A. The Administration believes that the private sector should be responsible for the final development and commercialization stages of new control technologies. The Federal Government, on the other hand, has an appropriate role in working with industry in the earlier stages of development, specifically in moving a new concept through the basic and applied research stages where a better understanding of the broad scientific and engineering principles can be obtained. By concentrating in these areas, the Federal Government can ensure that new technical concepts continue to emerge.

In the process of planning its research program, the Department solicits the views of a wide range of knowledgeable sources in the fossil energy research community through technical symposia, conferences, publications and by providing access to federal laboratories. Many DOE research activities are carried out by private industry under Federal contract. Cost-sharing is another approach available to obtain commitment of the private sector to a research activity as well as leveraging Federal research funds.

The latter approach has proven successful in the development of the technology of atmospheric fluidized bed concepts. Once technical viability of the concept was shown in Federally co-sponsored industrial-scale projects, private boiler manufacturers along with private research and engineering firms moved the technology into increasingly widespread commercial practice or developed larger-scale versions of it for utility applications.

DOE's fluidized bed combustion program is currently concentrating on higher-risk concepts having the potential to make coal competitive in smaller industrial boilers where oil or gas is now more economical. These concepts are being pursued primarily through Government contracts with industrial firms.

In coal preparation, the private sector has moved aggressively to develop improved coal cleaning techniques with a specific focus on the nearer-term objectives of increasing steam generator availability and reliability. The Energy Department, by comparison, has focused its attention on developing a sequence of advanced coal cleaning concepts that could be available in the 1990's and beyond. Many of these concepts are targeted on removing coal's organically-bound sulfur, currently unreachable with today's cleaning technologies.

Advanced flue gas cleanup technology -- focused primarily on the simultaneous removal of nitrogen and sulfur pollutants from coal combustion gases -- is also being pursued by DOE through contracts with private industry. An example of the involvement of the private sector in this research is a recently-awarded Federal cost-sharing contract to determine the technical feasibility of removing sulfur dioxide and nitrogen oxides simultaneously from flue gas using electron beams. In this project, involving a $6.2 million effort to install a small-scale electron-beam scrubber on an operating power station, the Department is contributing $3.6 million. The private sector, including three industrial organizations, five utilities, and the State of Indiana, will contribute the remainder of $2.6 million.

Q. 2. You have stated that the BER program is the only long-term multidisciplinary effort in the federal sector devoted to environmental and health effects related to existing or proposed energy technologies. The attached budget tables reflect substantial cuts in the areas of human health and environmental research. How has this altered the long-term effort?

A. Although there have been reductions in the budget for health and environmental research, the primary goal of the Biological and Environmental Research (BER) program remains the same. The goal is to understand the late biological effects, if any, that are produced by promising energy technologies.

In 1976, little information was available on the health and environmental effects associated with fossil energy processes or other long-term renewable energy technology developments. Because of this, an objective of the BER program in 1976 and the following years was to identify health and environmental issues associated with these technologies which might, in the future, constrain their use.

Funding for research to address these identified issues, especially in support of fossil energy technologies, was increased significantly, and extensive research of a short-term nature was initiated. The results of these experiments clearly demonstrated that the biologically active materials associated with the various synthetic fuel processes were, for the most part, identical. This information has made it possible to redirect the BER synthetic fuel-related research efforts. Since the redirected research is focused on fewer, longer-term experiments, funding can be reduced for this work and for equipment and construction items. With these reductions, other research activities will be maintained.

Q. 3. The potential threatening CO_2 problem--the so-called greenhouse effect--has been recognized for some time. You stated that the Department does not expect to be able to provide analyses for decision-making on the carbon dioxide until the early 1990's. Why so long?

A. The scientific data are not available. To estimate the effect of increased atmospheric CO_2 on agriculture, three models are needed with associated experimental data.

A model of the carbon cycle (the sources and reservoirs) is required to estimate future atmospheric CO_2 levels. A key carbon cycle research area is the uptake of CO_2 by oceans. Data from the North Atlantic Ocean is just being analyzed. It took two years to design the experiment and approximately two years for the cruise. Joint planning with NSF to study the South Atlantic is now under way - a five-year study program is being reviewed.

The second model that is required is a climate model capable of estimating the regional rate of CO_2 induced climate change. Improved climate models will require a five-year cloud data set from satellites, along with several additional years to develop the appropriate cloud submodels. In addition a better understanding of oceans is also required.

The third model required is to estimate the combined effect of climate change and direct CO_2 fertilization of crops. It will take on the order of 7 years to obtain the experimental data needed to develop and validate the model. We are just beginning the necessary experiments.

Along with these three models we must estimate how adaptable agricultural technology may be over the estimated range of the possible CO_2 change and of the possible climate change.

I believe you can see from this example that time is required to provide an analysis of the CO_2 issue. The National Academy study and our own analyses conclude that we have 10 years in which to develop the requisite scientific data base. To make a policy decision now, other than a research policy decision, with the present lack of data and verified models does not appear to be a logical or prudent approach.

Q. 4. Indoor air pollution is a significant problem with increased potential for public harm with widespread use of energy efficiency measures. What is the current funding level of DOE's research program? Does this represent an increase over the last five years? What other agencies are involved in research on this problem?

A. Current funding of the Department's program of research on indoor air pollution is $1.3 million. This research is conducted under the Ventilation and Indoor Air Quality (VIAQ) Program which is administered and funded by the Office of Conservation and Renewable Energy. The VIAQ Program encompasses work on (a) building pollutant concentrations, sources, emission characteristics, and controls; (b) air infiltration and ventilation in large buildings; (c) measurement of air leakage and infiltration; (d) perfluorocarbon trace air infiltration measurement system; and (e) data base comparison of measurement methods.

It should be noted that the Department's Office of Health and Environmental Research (OHER), Office of Energy Research, also supports health-related research on radioactive radon gas and certain chemicals (e.g., formaldehyde) that are of concern as toxic components of indoor air and as constituents of emissions or effluents associated with other energy technologies. This research is conducted as part of long-term, generic studies to develop a solid base of biological data on energy-related toxicants and is not focused on specific technology areas or issues. Therefore, this research is not categorized as part of the Department's program of research on indoor air quality even though the information developed may help resolve indoor air issues.

Over the past five years, funding of the VIAQ Program has decreased from $2.0 million (in FY 1979 and FY 1980) to $1.3 million in FY 1984. As research on building pollutant concentrations, sources, emission characteristics and controls was completed, some lower priority efforts were dropped while other projects were deferred or supported elsewhere, e.g., by EPA, HHS and CPSC. Overall funding for the VIAQ program has remained at nearly constant dollars from FY 1981 to FY 1984.

QUESTIONS FROM SENATOR BAUCUS

Q. 1. Is the Department of Energy performing any health effects research to study the problems associated with wood smoke emissions resulting from wood burning stoves and fireplaces?

A. Over a period of three years, the DOE Office of Health and Environmental Research supported a small project at the Department's Ames Laboratory (Iowa State University) for the purpose of obtaining a summary and analysis of available information on human health impacts of residential wood combustion. Work under this project has been completed, and the Laboratory submitted a technical report a year ago. This report provides an annotated bibliography containing nearly 450 references. It also identifies six areas of research that warrant further active investigation in order to improve understanding of health effects of residential wood burning. Of particular importance is the need for (a) developing improved sampling equipment and procedures for collecting representative samples of complex emissions from wood combustion and (b) utilizing new or improved methods for determining (and measuring) the kinds of organic compounds that are components of emissions from wood stoves.

At present, no research on health effects of emissions from wood combustion is in progress or planned by DOE.

Q. 2. EPA has considerably reduced the budget for energy research activities other than acid rain, since synthetic fuels development is slowing down. Has DOE adopted the same policy towards synfuels development and research?

—Has DOE been affected by the reductions in EPA control technology development efforts?

A. DOE continues to believe that synthetic fuels is an important and appropriate area for long-term, Federally-sponsored environmental research. While the DOE synfuels technology development effort was significantly reduced several years ago through the termination of demonstration and pilot plant activities, a strong basic and applied research program continues. This is equally true of environmental/synfuels activities where the primary reductions have been in site-specific activities associated with the demonstration and pilot plants. As indicated in my testimony of October 17, 1983 (pages 4-5), the Office of Health and Environmental Research (OHER), using short-term biological and chemical investigations, has developed over the past several years (FY 1978 - FY 1982) a very substantial health and environmental data base related to the development of synthetic fuel processes. This information was developed in close cooperation with the Fossil Energy program.

During the latter part of FY 1982 and early part of FY 1983, however, DOE commissioned several studies to evaluate this short-term health and environmental data base in order to determine the future direction which our synthetic fuels-related research should take. On the basis of these evaluations, OHER began to redirect its research efforts related to the production of synthetic fuels along lines which focused on longer-term, more generic health and environmental issues. The objective of this research was to determine the late biological effects, such as cancer, mutation, and developmental and reproductive effects, which might be produced by chronic exposure to low levels of synthetic fuel-related pollutants. The redirection of research effort was made independently of, but was compatible with, the decision by the Administration to reduce its efforts in the development, demonstration, and commercialization of synthetic fuel processes.

DOE has not been affected by reductions in the EPA control technology development effort. These reductions have taken place primarily in the areas of near-term flue gas desulfurization (FDG) process improvement and development covering areas such as organic acid additions for improvement of limestone scrubber performance, forced oxidation to alleviate scrubber waste handling and disposal problems, and the development of dual alkali wet scrubbing processes. DOE, on the other hand, has been concentrating on long-term research and development or processes with the potential for simultaneous removal of both SO_x and NO_x from coal-fired boiler flue gas streams; in essence, "the next generation" of control technology.

Q. 3. Does DOE do any research into non-ionizing radiation exposure health effects? If so, does DOE coordinate their program with EPA's?

A. The Department sponsors research on health effects related to non-ionizing radiation of several different types. Three distinct categories of research can be identified, as follows:

- Evaluation of possible human health impacts resulting from electromagnetic fields of the type that are associated with overhead high-voltage electric transmission lines.

  Physical fields of specific interest are 60-Hertz electric and magnetic fields as well as d-c electric fields. This is the largest of the three ongoing research efforts and includes research to (a) develop improved methods of measuring, monitoring, and calibrating electromagnetic fields of interest; (b) measure electric field parameters under representative operating transmission lines and under advanced ultra high-voltage prototype (i.e., experimental) lines (both a-c and d-c); (c) determine and understand biological properties of relevant electromagnetic fields in laboratory animals and other experimental biological systems; (d) conduct planning and preliminary work preparatory to the implementation of an epidemiologic study of health indices in workers occupationally exposed to 60-Hertz electric fields, and (e) develop plans and strategies for the conduct of an assessment of health risks associated associated with human exposures to transmission line related electromagnetic fields. Work related to the human epidemiologic study is being conducted and funded by the Bonneville Power Administration.

All other transmission line related work is currently supported by the Electric Energy Systems Division, Office of Conservation and Renewable Energy.

- Research to define biological and health effects of strong d-c magnetic fields.

  Strong d-c fields are of interest because they are generated by magnetic fusion energy systems and several other energy-related technologies. Included in this research category is (a) generic research to define the biological properties of d-c magnetic fields in laboratory animals and other model systems, and (b) work on the development of personnel dosimeters capable of measuring worker exposures to d-c magnetic fields. This research is directed and funded by the Office of Health and Environmental Research, Office of Energy Research.

- Research on biological properties of ultraviolet (UV) radiation.

  This is basic research designed to elucidate mechanisms underlying biological actions of UV radiation. Ongoing and planned research is part of a broad, generic study to determine how living systems respond to stressful external perturbations and includes, for example, a number of studies on the production and repair of UV-induced DNA damage. The Office of Health and Environmental Research also sponsors this work.

The DOE staff coordinates the Department's program with EPA through periodic meetings of the Interagency Committee on Electric Field Effects from High Voltage Lines, the most recent of which was held on August 22, 1983. The Committee was organized and is chaired by DOE. EPA is one of over a dozen member agencies.

STATEMENT OF
DR. ALBERT L. BRIDGEWATER
ACTING ASSISTANT DIRECTOR
ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES
NATIONAL SCIENCE FOUNDATION

BEFORE THE

SENATE PUBLIC WORKS COMMITTEE
SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT

OCTOBER 17, 1983

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I AM PLEASED TO HAVE THE OPPORTUNITY TO PRESENT TESTIMONY TODAY, ON BEHALF OF THE NATIONAL SCIENCE FOUNDATION (NSF). THE PURPOSE OF THIS TESTIMONY IS TO FAMILIARIZE YOU WITH NSF'S ROLE IN ENVIRONMENTAL SCIENCE AND OUR RELATIONSHIP TO MISSION-ORIENTED AGENCIES WHICH ADDRESS OUR NATION'S EMERGENT ENVIRONMENTAL CONCERNS.

TO THIS END I FIRST WILL DEFINE THE NSF'S OVERALL MISSION, AND THEN I WILL DESCRIBE NSF'S ROLE WITH RESPECT TO ENVIRONMENTAL SCIENCE.

THE NATIONAL SCIENCE FOUNDATION, AS AN INDEPENDENT FEDERAL AGENCY UNDER THE AUTHORITY OF THE NSF ACT OF 1950, HAS THE MISSION OF SUPPORTING BASIC SCIENTIFIC RESEARCH IN ORDER TO MAINTAIN AND INCREASE THE NATION'S CAPABILITY IN SCIENTIFIC AND TECHNOLOGICAL AREAS.

THE NSF DOES NOT ITSELF CONDUCT RESEARCH. INSTEAD WE FUND SCIENTISTS IN THE PRIVATE SECTOR WHO PERFORM RESEARCH IN ACADEMIC INSTITUTIONS, AT NATIONAL FACILITIES, OR IN ISOLATED CASES IN INDUSTRIAL LABORATORIES. UNSOLICITED PROPOSALS ARE RECEIVED AND EVALUATED THROUGH A PEER REVIEW PROCESS INVOLVING BOTH AD HOC REVIEWS AND/OR REVIEW BY A PANEL OF EXPERTS. AWARDS ARE MADE BASED ON SCIENTIFIC MERIT. THE OBJECTIVES, METHODS, ULTIMATE GOALS, AND PACE OF THE RESEARCH ALL ARE DETERMINED BY THE SCIENTISTS PROPOSING THE RESEARCH.

NSF'S ROLE IN ENVIRONMENTAL RESEARCH IS TO FOSTER DEVELOPMENT OF BASIC UNDERSTANDING OF THE EARTH, ATMOSPHERE, OCEANS, BIOLOGICAL SYSTEMS, AND SOME ASPECTS OF ENGINEERING THAT AFFECT OR ARE AFFECTED BY THE ENVIRONMENT. TIMELY RESOLUTION OF TODAY'S ENVIRONMENTAL PROBLEMS REQUIRES BASIC UNDERSTANDING OF THE PRIMARY PHENOMENA INVOLVED. THIS UNDERSTANDING DEVELOPS SLOWLY THROUGH THE LONG-TERM PROCESS OF SCIENTIFIC INVESTIGATION.

RESEARCH DISCOVERIES PRECEDE AND UNDERLIE ADVANCES IN MANY AREAS OF FEDERAL RESPONSIBILITY, INCLUDING ENVIRONMENTAL SCIENCE. FUNDAMENTAL RESEARCH IN PHYSICAL, CHEMICAL, BIOLOGICAL, AND ENVIRONMENTAL PROCESSES, WHILE NOT ADDRESSING CURRENT ENVIRONMENTAL CONCERNS SPECIFICALLY, NEVERTHELESS IS THE NECESSARY FORERUNNER TO THE IDENTIFICATION OF ENVIRONMENTAL PROBLEMS. AS A SECOND STEP, THE MISSION AGENCIES THROUGH APPLIED RESEARCH PROGRAMS BUILD UPON THE GRADUALLY ADVANCING FRONTS OF BASIC SCIENCE IN THE QUEST FOR SOLUTIONS TO

THESE ENVIRONMENTAL PROBLEMS. NSF HISTORICALLY HAS SUPPORTED RESEARCH THAT IN LATER YEARS PROVIDED A SCIENTIFIC DATA BASE FOR ATTEMPTS TO UNDERSTAND EMERGING ENVIRONMENTAL ISSUES. NSF-SUPPORTED SCIENTISTS CONSISTENTLY HAVE HAD A SIGNIFICANT ROLE IN PROVIDING FUNDAMENTAL KNOWLEDGE AS WELL AS ASSISTANCE AND GUIDANCE IN PLANNING FOR, INTERPRETING, AND MONITORING OF NATIONAL ENVIRONMENTAL ISSUES.

LET ME MENTION AN EXAMPLE. THE NSF DIVISION OF BIOTIC SYSTEMS AND RESOURCES, OVER THE PAST TWO DECADES HAS SUPPORTED THE RESEARCH OF DRS. GENE LIKENS (NEW YORK BOTANICAL GARDEN) AND F. HERBERT BORMANN (YALE) WORKING WITH DR. ROBERT PIERCE (USDA/FOREST SERVICE) AT THE FOREST SERVICE'S HUBBARD BROOK EXPERIMENTAL FOREST IN NEW HAMPSHIRE. THIS RESEARCH PROVIDED THE FIRST CONFIRMATION OF HIGH LEVELS OF ACIDITY IN RAINFALL OVER THE NORTHEASTERN U.S. THAT THIS PROJECT CONTINUES TO CONTRIBUTE FUNDAMENTAL KNOWLEDGE ABOUT THE BIOGEOCHEMISTRY OF SULFUR, NITROGEN AND METALS IS WITNESSED BY THE RECENT PROPOSAL OF A MECHANISM BY WHICH ALUMINUM IS MOBILIZED AND TRANSPORTED TO AQUATIC ENVIRONMENTS.

SIMILARLY, NSF'S DIVISION OF ATMOSPHERIC SCIENCES HAS LONG FUNDED RESEARCH ON THE CHEMISTRY OF CLOUD DROPLETS AND PRECIPITATION.

A THIRD EXAMPLE OF NSF'S EARLY SUPPORT OF FUNDAMENTAL RESEARCH CAME FROM ATMOSPHERIC SCIENCE WHICH 20 YEARS AGO BEGAN LAYING GROUNDWORK WHICH LATER WOULD FACILITATE NATIONAL AND INTERNATIONAL PROGRAMS CONCERNED WITH SUCH PROBLEMS AS URBAN AIR POLLUTION AND STRATOSPHERIC OZONE DEPLETION.

THE THEME OF LONG-TERM RESEARCH SUPPORT FOR GRADUAL SCIENTIFIC ADVANCEMENT IS SEEN IN THE PROGRAMS CURRENTLY SUPPORTED BY NSF.

THE DIVISION OF BIOTIC SYSTEMS AND RESOURCES (BSR) THROUGH THE DIRECTORATE OF BIOLOGY AND BEHAVIORAL SCIENCES (BBS) ADDRESSES SEVERAL ENVIRONMENT-RELATED PROGRAMS. THE OBJECTIVE OF BSR IS TO ADVANCE KNOWLEDGE OF THE ATTRIBUTES AND INTERRELATIONS OF ORGANISMS AS THEY EXIST IN THEIR NATURAL ENVIRONMENT. TAKEN AS A WHOLE, THIS ENCOMPASSES THE SUBDISCIPLINES OF SYSTEMATICS, POPULATION BIOLOGY AND PHYSIOLOGICAL ECOLOGY, ECOLOGY, AND ECOSYSTEM STUDIES. OF THE BASIC RESEARCH SUPPORT FOR ENVIRONMENTAL BIOLOGY TO COLLEGES AND UNIVERSITIES, NSF PROVIDES 95 PERCENT OF THE TOTAL. NSF'S SUPPORT REPRESENTS 50 PERCENT OF ALL FUNDING FOR BASIC RESEARCH IN ENVIRONMENTAL BIOLOGY ACROSS THE FEDERAL GOVERNMENT.

THE DIVISION RECOGNIZES IN PLANNING AND BUDGET REQUESTS CERTAIN HIGH PRIORITY AREAS FOR INCREASED RESEARCH SUPPORT. THESE INCLUDE: RESEARCH ON PLANT BIOLOGY, ESPECIALLY INTERACTIONS OF PLANTS AND INSECT HERBIVORES, AND PLANTS AND SOIL MICROORGANISMS, AS WELL AS CHARACTERIZATION OF GENETIC AND BIOLOGICAL DIVERSITY OF RELATIVES OF CULTIVATED PLANTS; APPLICATION OF MOLECULAR GENETICS TO SYSTEMATIC AND POPULATION BIOLOGY; LINKAGES IN THE TRANSFORMATIONS OF BIOGENIC ELEMENTS--CARBON, NITROGEN, SULFUR AND PHOSPHORUS--IN SOILS AND SEDIMENTS; AND THE SYSTEMATIC RELATIONSHIPS OF PRIMITIVE MICROORGANISMS. RESEARCH PRIORITIES ARE DEVELOPED AS PART OF THE DIVISION'S LONG-RANGE PLANNING AND BUDGET PROCESS WHICH EMBODIES TOP-DOWN AND BOTTOM-UP

CONSIDERATIONS. SUCH CONSIDERATIONS REFLECT THE CONCERNS OF THE SCIENTIFIC COMMUNITY EVIDENT IN THE RESEARCH THEY PROPOSE, IN RECOMMENDATIONS OFFERED BY ADVISORY PANELS AND IN THE COMMUNITY CONSENSUS OBTAINED THROUGH TOPICAL WORKSHOPS.

THE LONG-TERM NATURE OF PROGRESS IN BASIC RESEARCH PARTICULARLY IS TRUE IN ENVIRONMENTAL BIOLOGY BECAUSE MANY ENVIRONMENTAL PROCESSES RUN THEIR COURSE OVER LONG PERIODS OF TIME (SUCCESSION), WHILE OTHERS OCCUR INFREQUENTLY BUT WITH BOTH WIDESPREAD AND CATASTROPIC CONSEQUENCES (FIRE, STORMS, DROUGHTS). DEVELOPMENT OF THE REQUISITE FUNDAMENTAL KNOWLEDGE REQUIRES RESEARCH SPANNING DECADES--A CAREER--AND REPRESENTATIVE SITES FOR SUCH DEDICATED RESEARCH POSE UNIQUE LOGISTICAL REQUIREMENTS. A RECENT ARTICLE FROM MOSIAC IS SUBMITTED FOR THE RECORD (MOSAIC 14/4, 1983). THE NEED FOR SUCH LONG TERM STUDY WAS RECOGNIZED BY THE FOUNDATION SEVERAL YEARS AGO AND THROUGH A SERIES OF CONFERENCES AND WORKING SESSIONS BEGINNING IN 1976, CONSENSUS WAS DEVELOPED ON SITE REQUIREMENTS AND SCIENTIFIC CRITERIA THAT SHOULD SERVE THE DEVELOPMENT OF LONG TERM ECOLOGICAL RESEARCH. THROUGH A SERIES OF TWO SPECIAL PROPOSAL SOLICITATIONS AND PEER REVIEWS, ELEVEN SUCH SITES WERE SELECTED AND FUNDED FOR AN INITIAL PERIOD OF 5 YEARS TO PURSUE INVESTIGATION OF LONG-TERM PROCESSES AND PHENOMENA THAT ARE SO IMPORTANT IN UNDERSTANDING THE FUNDAMENTAL NATURE OF HOW THE ENVIRONMENT OPERATES. THE 1983 BROCHURE ENTITLED "LONG-TERM ECOLOGICAL RESEARCH (LTER) IN THE U.S.," IS SUBMITTED FOR THE RECORD. SEVERAL OF THESE SITES ARE LOCATED AT FIELD EXPERIMENTAL FACILITIES OF UNITED STATES DEPARTMENT OF AGRICULTURE/AGRICULTURAL RESEARCH SERVICE (USDA/ARS) AND UNITED STATES DEPARTMENT OF AGRICULTURE/FOREST SERVICE (USDA/FS) WITH JOINT SCIENTIFIC

PARTICIPATION BY UNIVERSITY SCIENTISTS AND THEIR FEDERAL COUNTERPARTS. OTHER AGENCIES HAVE SEEN THE VALUE OF LOCATING SPECIFIC SHORT-TERM STUDIES AT LTER SITES BECAUSE OF THE SCIENTIFIC VALUE OF INTERPRETING SHORT-TERM RESULTS IN THE CONTEXT OF A LONG-TERM DATA BASE.

MANY PROJECTS SUPPORTED BY THE DIVISION OF BIOTIC SYSTEMS RESOURCES (BSR), ESPECIALLY MULTIDISCIPLINARY STUDY OF ENTIRE ECOSYSTEMS, OWE THEIR SUCCESS TO THE FORMAL COOPERATION BETWEEN UNIVERSITY SCIENTISTS AND FEDERAL SCIENTISTS AT USDA/ARS AND USDA/FS EXPERIMENTAL FIELD FACILITIES. NOTABLE AMONG THESE COOPERATIONS ARE PROJECTS AT COWEETA HYDROLOGIC LABORATORY, NORTH CAROLINA (USDA/FS), H. J. ANDREWS EXPERIMENTAL FOREST, OREGON (USDA/FS), CENTRAL PLAINS EXPERIMENTAL RANGE, COLORADO (USDA/ARS), AND OF COURSE, HUBBARD BROOK. AT HIGHER LEVELS OF COORDINATION, NSF AS A WHOLE IS FULLY INVOLVED IN SEVERAL INTERAGENCY MECHANISMS FOR RESEARCH COORDINATION. ONE EXAMPLE IS THE NATIONAL ACID PRECIPITATION ASSESSMENT PROGRAM (NAPAP) OF WHICH NSF IS A MEMBER OF THE TASK FORCE. BECAUSE OF ITS UNIQUE ROLE IN THE SUPPORT OF INVESTIGATOR-INITIATED BASIC RESEARCH, NSF IS NOT PART OF THE INTERAGENCY BUDGETING PROCESS BUT NONETHELESS PARTICIPATES IN THE TECHNICAL AFFAIRS OF THIS EFFORT AND MORE IMPORTANTLY SEEKS TO COMMUNICATE THE RESULTS IN THE BASIC SCIENCE IN ATMOSPHERIC AND BIOLOGICAL DISCIPLINES SUPPORTED BY NSF THAT POTENTIALLY CONTRIBUTES TO THIS ISSUE. IN FY 1982, NSF SUPPORTED SOME 30 BASIC RESEARCH PROJECTS RELATED TO THE SPECIFIC RESEARCH TASKS OF NAPAP. GIVEN ITS IMPORTANCE AND SCIENTISTS' PERCEPTION OF BASIC RESEARCH NEEDS WE WOULD EXPECT THIS LEVEL OF ACTIVITY TO CONTINUE. EXAMPLES OF OTHER INTERAGENCY RESEARCH COORDINATION, FOR THE DIVISION OF BSR ARE: CO_2 AND CLIMATE, BIOLOGICAL DIVERSITY AND PLANT BIOLOGY, AND EPA'S ANTICIPATORY RESEARCH PROGRAM. FORMAL

COOPERATION (I.E., JOINT FUNDING) OCCURS ON AN AD HOC BASIS AS DICTATED BY THE PARTICULAR PROJECT. SIMILAR COOPERATIVE EFFORTS ARE CONDUCTED IN THE OTHER NSF DIRECTORATES.

TWO PROGRAMS IN THE DIVISION OF CIVIL AND ENVIRONMENTAL ENGINEERING THROUGH THE DIRECTORATE OF ENGINEERING PROVIDE SUPPORT FOR FUNDAMENTAL RESEARCH RELATING TO ENVIRONMENTAL MATTERS:

1. ENVIRONMENTAL AND WATER QUALITY ENGINEERING SUPPORTS RESEARCH DIRECTED TOWARD OBTAINING A BETTER UNDERSTANDING OF FUNDAMENTAL PRINCIPLES UNDERLYING PROCEDURES USED IN ENGINEERING PRACTICE RELATING TO QUALITY ASPECTS OF: WATER SUPPLY, STORM AND SANITARY DRAINAGE, WATER AND WASTEWATER TREATMENT, AND DIFFUSION, DISPERSION AND INTERACTIONS OF ENVIRONMENTAL POLLUTANTS.

RECENT EMPHASIS IN THE ENVIRONMENTAL AND WATER QUALITY ENGINEERING PROGRAM HAS BEEN ON APPROACHES TO DEALING WITH POLLUTANTS SUCH AS HALOGENATED HYDROCARBON CONTAMINANTS IN WATER AND WASTEWATER, THE SEARCH FOR A BETTER BASIC UNDERSTANDING OF WASTEWATER TREATMENT PROCESSES AS A STEP TOWARD PROCESS AND SYSTEMS IMPROVEMENT, AND ON ENVIRONMENTAL EFFECTS OF POLLUTANTS DERIVED FROM URBAN STORMWATER DRAINAGE.

2. HYDRAULICS, HYDROLOGY, AND WATER RESOURCES ENGINEERING IS A RESEARCH PROGRAM WITH TWO GOALS. THE FIRST GOAL IS A BETTER UNDERSTANDING OF NATURAL PHYSICAL PHENOMENA OF ENGINEERING INTEREST, THE SECOND GOAL IS THE BUILDING OF A SCIENTIFIC FOUNDATION UNDER THE EMPIRICAL PRACTICES AND PROCEDURES OFTEN

FOUND IN HYDRAULICS, HYDROLOGY, AND WATER RESOURCES ENGINEERING. AREAS OF RESEARCH CURRENTLY SUPPORTED WHICH ARE RELATED TO ENVIRONMENTAL ISSUES INCLUDE SUCH TOPICS AS GROUNDWATER FLOW AND EROSION AND SEDIMENT TRANSPORT.

NSF HAS ON OCCASION COOPERATED WITH EPA IN VARIOUS CONFERENCES AND WORKSHOPS. EXAMPLES OF THESE CONDUCTED DURING FY 1983 THROUGH THE DIVISION OF CIVIL AND ENVIRONMENTAL ENGINEERING INCLUDE:

"INTERNATIONAL SYMPOSIUM ON GAS TRANSFER AT WATER SURFACES" AT CORNELL UNIVERSITY IN JUNE OF 1983.

"INTERNATIONAL SYMPOSIUM ON URBAN HYDROLOGY" AT THE 1983 AMERICAN GEOPHYSICAL UNION MEETING IN BALTIMORE, MARYLAND, IN MAY OF 1983.

"FUNDAMENTAL RESEARCH NEEDS FOR WATER AND WASTEWATER SYSTEMS," ASSOCIATION OF ENVIRONMENTAL ENGINEERING PROFESSORS, IN WASHINGTON, D.C. IN DECEMBER OF 1982.

INDIVIDUAL INVESTIGATORS ALSO MAY RELATE FUNDAMENTAL RESEARCH BEING SUPPORTED BY NSF TO APPLICATION IN RESEARCH DEVELOPMENT OR DEMONSTRATION PROJECTS THEY MAY BE CONDUCTING WITH OTHER FEDERAL AGENCY SUPPORT. FOR EXAMPLE NSF-FUNDED BASIC RESEARCH CONDUCTED AT NOTRE DAME UNIVERSITY ON SEQUENCING BATCH REACTORS AS AN ALTERNATIVE TO CONTINUOUS-FLOW SYSTEMS IN 1976-78 LED TO AN EPA-FUNDED DEMONSTRATION PROJECT USING THIS CONCEPT AT CULVER, INDIANA FROM 1979-82. A PROJECT CONDUCTED AT THE UNIVERSITY OF MINNESOTA ON THE ECOLOGICAL BIOCHEMISTRY OF AROMATIC COMPOUND DEGRADATION IN NATURAL WATERS FROM 1980-83

WAS INSTRUMENTAL IN DEVELOPING ANALYTICAL PROCEDURES NOW BEING USED ON A PROJECT FUNDED BY EPA ON DEGRADATION OF PHENOLIC COMPOUNDS IN NATURAL WATERS.

THE DIRECTORATE FOR ASTRONOMICAL, ATMOSPHERIC, EARTH, AND OCEAN SCIENCES (AAEO) HAS SEVERAL PROGRAMS DIRECTED TOWARDS ENVIRONMENTAL SCIENCE. AS MENTIONED EARLIER, THE DIVISION OF ATMOSPHERIC SCIENCES (ATM), SUPPORTS ONGOING STUDY OF URBAN AIR POLLUTION, OZONE DEPLETION, AND ACID RAIN.

THE DIVISION OF ATMOSPHERIC SCIENCES SUPPORTS BASIC RESEARCH ON THE CHEMICAL AND PHYSICAL PROCESSES THAT DETERMINE THE CYCLING OF CONTAMINANTS AND NATURAL ATMOSPHERIC CONSTITUENTS THROUGH BOTH THE TROPOSPHERE AND STRATOSPHERE. RESEARCH ON ATMOSPHERIC MOTION ALLOWS SCIENTISTS TO SIMULATE MATHEMATICALLY THE CHEMICAL AND PHYSICAL ATMOSPHERIC PHENOMENA AND THEREBY PREDICT FUTURE TRENDS IN CHEMISTRY OF THE ATMOSPHERE. RESEARCH SUPPORT FOR SUCH STUDIES IS PROVIDED BY PROGRAMS IN ATMOSPHERIC CHEMISTRY, METEOROLOGY, AERONOMY, AND CLIMATE DYNAMICS. APPROXIMATELY 15 PERCENT OF GRANTS CURRENTLY FUNDED THROUGH THE ATMOSPHERIC CHEMISTRY PROGRAM ARE RELATED TO AIR POLLUTION, OZONE DEPLETION, OR ACID RAIN.

EXAMPLES OF ATM SUPPORTED ACTIVITIES WHICH CONTRIBUTE BASIC KNOWLEDGE TO THE NATIONAL EFFORTS WITHIN THESE THREE AREAS OF ENVIRONMENTAL CONCERN ARE:

1. PHOTOCHEMICAL REACTION AND AEROSOL FORMATION MECHANISMS AT PENNSYLVANIA STATE, UNIVERSITY OF CALIFORNIA AT RIVERSIDE, AND CALTECH.

2. STUDIES OF CLOUD AND PRECIPITATION CHEMISTRY AND PHYSICS AT WHITE FACE MOUNTAIN, NY, AND OTHER LOCATIONS BY SCIENTISTS FROM SUNY ALBANY, UNIVERSITY OF MINNESOTA, UNIVERSITY OF WASHINGTON, AND COLORADO COLLEGE.

3. STUDIES OF THE ATMOSPHERIC CONCENTRATION AND DISTRIBUTION OF GASES IMPORTANT TO THE STRATOSPHERIC CHEMISTRY OF OZONE BY SCIENTISTS FROM WASHINGTON STATE UNIVERSITY, OREGON GRADUATE CENTER, STANFORD RESEARCH INSTITUTE (SRI), AND THE UNIVERSITY OF CALIFORNIA AT SAN DIEGO, AND THE MEASUREMENT OF STRATOSPHERIC SPECIES BY GROUND BASED AND BALLOON BORNE TECHNIQUES BY SCIENTISTS FROM THE UNIVERSITY OF DENVER, FLORIDA ATLANTIC, AND THE UNIVERSITY OF WYOMING.

NSF ALSO FUNDS THROUGH THE DIVISION OF ATMOSPHERIC SCIENCES THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR) A FACILITY WHICH CONDUCTS BASIC RESEARCH UNDER ESSENTIALLY THE SAME PHILOSOPHY AS DESCRIBED FOR THE NSF GRANTS PROGRAM. PART OF NCAR'S EFFORTS RELATE TO THE SPECIFIC ENVIRONMENTAL PROBLEM AREAS DISCUSSED PREVIOUSLY.

BECAUSE OF ITS UNIQUE FACILITIES FOR ATMOSPHERIC RESEARCH NCAR ALSO CAN AND DOES PROVIDE DIRECT AND REIMBURSABLE SUPPORT TO THE MISSION AGENCIES IN THEIR APPLIED RESEARCH EFFORTS. THIS SUPPORT INCLUDES PROVIDING ACCESS TO COMPUTATION, AVIATION, AND FIELD FACILITIES. MISSION AGENCY SUPPORT MAKES POSSIBLE PARTICIPATION BY NCAR SCIENTISTS IN BOTH APPLIED OR DEVELOPMENTAL RESEARCH. I WOULD LIKE TO MENTION THREE SPECIFIC PROGRAMS CONDUCTED AT NCAR:

1. Extensive NCAR participation in the EPA sponsored Acid Precipitation Experiment (APEX),

2. Involvement of NCAR scientists in cooperation with the EPA in the Denver Brown Cloud Experiment which was a program aimed at understanding Denver's air pollution problems. Pollutant emissions, economic activity, and population growth were factors used to project air quality effects in Denver.

3. Current development by NCAR scientists, under EPA sponsorship, of a new generation acid rain model known as the Eulerian Acid Deposition Model System which better will serve the research and regulatory needs associated with this national problem.

AAEO'S Division of Ocean Science supports basic research relevant to questions of marine pollution. Because so little is known about the ecological dynamics of all parts of the marine ecosystem, basic findings make a contribution to other more directly applied studies. The new understanding of marine systems gained through NSF-supported research forms the basis for considerable marine pollution research currently supported by mission agencies.

The programs within the Ocean Sciences Division are divided along disciplinary lines: Physical Oceanography, Marine Chemistry, Submarine Geology and Geophysics, and Biological Oceanography. Within the Division there essentially are two categories of research. There are specific study areas in

WHICH A VARIETY OF INDIVIDUAL PROJECTS MAY BE SUPPORTED, AND THERE ARE MULTICOMPONENT PROJECTS INVOLVING LARGER NUMBERS OF INVESTIGATORS ADDRESSING A SPECIFIC SET OF GOALS.

ONE MAJOR PROJECT ADDRESSING EFFECTS OF POLLUTION ON MARINE ORGANISMS IS THE POLLUTANT RESPONSE IN MARINE ANIMALS (PRIMA), A 5-YEAR EFFORT TO BE PHASED OUT IN FY 1984. THE PROJECT IS A CLOSELY COORDINATED LABORATORY AND FIELD STUDY WHICH USES COMMON EXPERIMENTAL FACILITIES AND FIELD SITES. THE GENERAL OBJECTIVES ARE TO STUDY THE EFFECTS OF SELECTED HYDROCARBONS ON REPRESENTATIVE SPECIES OF MARINE ORGANISMS BY DETERMINING: (1) THE ACCUMULATION OF TEST CHEMICALS IN TISSUES OF EXPOSED ANIMALS; (2) THE CHANGES IN ACTIVITY OF BIOTRANSFORMING ENZYMES; (3) THE CHANGES IN METABOLIC PRODUCTS ASSOCIATED WITH STRESS REACTIONS; (4) THE CHANGES IN CELL AND TISSUE STRUCTURE; AND (5) THE CHANGES IN DEFENSE RESPONSES TO INFECTIONS AND/OR FOREIGN SUBSTANCES. SPECIFICALLY, THE INVESTIGATORS PARTICIPATE IN THE FOLLOWING ACTIVITIES:

1. DETERMINE THE EFFECTS OF LOW-LEVEL, LONG TERM EXPOSURE TO POLLUTANTS ON THE HISTOLOGY OF VARIOUS TISSUES AND ORGANS OF EXPERIMENTAL ANIMALS. LIGHT AND ELECTRON MICROSCOPE METHODS ARE USED TO DETECT AND EVALUATE CELLULAR AND TISSUE LESIONS AND ANOMALIES RESULTING FROM POLLUTANT EXPOSURE.

2. MEASURE THE RATES OF ACCUMULATION, DISTRIBUTION, METABOLIC TRANSFORMATION AND RELEASE OF SELECTED ORGANIC POLLUTANTS BY MARINE ANIMALS. EMPHASIS IS PLACED ON DETERMINING THE PRESENCE OF CERTAIN MIXED FUNCTION OXYGENASE SYSTEMS (ENZYME SYSTEMS INVOLVED IN THE BIOTRANSFORMATION OF FOREIGN COMPOUNDS) IN THE TISSUE OF THE EXPERIMENTAL ANIMALS AS WELL AS THE EXTENT TO WHICH THESE SYSTEMS ARE INDUCED IN ANIMALS EXPOSED TO DIFFERENT ORGANIC POLLUTANTS.

3. CLARIFY THE RESPONSE OF IMMUNE SYSTEMS IN MARINE ANIMALS TO LONG TERM LOW-LEVEL POLLUTANT EXPOSURE. THE ABILITY OF POLLUTANT-EXPOSED FISH TO RESPOND TO INFECTION AND/OR FOREIGN SUBSTANCES IS DETERMINED BY MEASURING THE AMOUNT AND/OR ACTIVITY OF CERTAIN TYPES OF ANTIBODIES, AND THE ORGANISM'S ABILITY TO REJECT TRANSPLANTED SCALES. ALTERATIONS IN IMMUNE REACTIONS OF CELLS OR CERTAIN COMPONENTS (ANTIBODIES) OF THE BLOOD IN POLLUTANT-EXPOSED MARINE INVERTEBRATES WILL BE QUANTIFIED. ADDITIONAL ASSAYS INCLUDE HEMOCYTE PHAGOCYTIC ACTIVITY AND THE AMOUNT AND TYPE OF LYSOSOMAL ENZYME ACTIVITY.

4. DETERMINE THE EFFECTS OF LONG TERM LOW-LEVEL POLLUTANT EXPOSURE ON THE ADRENOCORTICAL STRESS RESPONSE IN FISH AND THE ANALOGOUS BIOCHEMICAL STRESS RESPONSES IN INVERTEBRATES. THE AMOUNT OF STEROIDS (PRODUCED IN THE ADRENAL CORTEX) FOUND IN THE BLOOD AND THE RATE OF PRODUCTION AND DEGRADATION OF CORTISOL IS MEASURED IN POLLUTANT-EXPOSED FISH; ALTERATIONS OF CORTISOL DYNAMICS IS RELATED TO ASCORBIC ACID DEPLETION AND CHANGES IN BLOOD GLUCOSE.

5. INTEGRATE AND CORRELATE ALL ASPECTS OF THE PROGRAM SO THAT CAUSE AND EFFECT RELATIONSHIPS CAN BE ESTABLISHED.

THE WORK IS BEING CARRIED OUT BY SIX SENIOR INVESTIGATORS FROM FIVE INSTITUTIONS AS FOLLOWS:

DR. R. ANDERSON	SLOAN-KETTERING INSTITUTE FOR CANCER RESEARCH
DR. C. GIAM	TEXAS A & M UNIVERSITY
DR. R. LEE	SKIDAWAY INSTITUTE OF OCEANOGRAPHY
DR. J. NEFF	TEXAS A & M UNIVERSITY
DR. J. STEGEMAN	WOODS HOLE OCEANOGRAPHIC INSTITUTION
DR. M. TRIPP	UNIVERSITY OF DELAWARE

THE DIVISION OF EARTH SCIENCES ADDRESSES ENVIRONMENTAL PROBLEMS THROUGH ITS PROGRAM OF ENVIRONMENTAL GEOSCIENCES, WHICH CAME INTO EXISTENCE IN 1982. THE FOCUS ON BASIC RESEARCH RELATED TO NATURAL HAZARDS PRODUCES A WIDE RANGE OF PROJECTS. AS IS THE CASE WITH ALL BASIC RESEARCH, APPLICATIONS TO OUR

KNOWLEDGE OF TOXICITY OR POLLUTION MAY BE DIRECTLY OR INDIRECTLY INFERRED. I ACCORDINGLY HAVE SELECTED FOR MENTION SEVERAL PROPOSALS WHOSE TITLES ILLUSTRATE A RELATIONSHIP TO AN ENVIRONMENTAL PROBLEM:

> NATIONAL ACADEMY, "PARTIAL SUPPORT OF A STUDY PANEL ON GEOCHEMISTRY OF FIBROUS MATERIALS RELATED TO HEALTH RISKS AND SUBCOMMITTEE ON GEOCHEMICAL ENVIRONMENT AND HEALTH DISEASES," 12 MONTHS. TOXIC SUBSTANCES, ENVIRONMENT.
>
> D. WASLENCHUK, UNIVERSITY OF CONNECTICUT, "GEOCHEMISTRIES OF THE METALLOIDS ARSENIC, ANTIMONY, BISMUTH, GERMANIUM AND SELENIUM IN U.S. RIVERS," 12 MONTHS. TOXIC ELEMENTS, U.S. RIVERS.
>
> P. QUAY, UNIVERSITY OF WASHINGTON, "FRESHWATER CARBON CYCLE," 24 MONTHS. EFFECTS CHEM. NUTRIENTS ON L. WASHINGTON.
>
> H. J. SIMPSON, COLUMBIA, "ENVIRONMENTAL ISOTOPIC COMPOSITION OF RIVERS AND GROUNDWATER IN JAMAICA," 24 MONTHS WITH FUNDS FROM NSF'S DIVISION OF INTERNATIONAL PROGRAMS (INT) DEVELOPING COUNTRIES PROGRAM. SEVERAL ISOTOPIC MEASUREMENTS TO DETERMINE DIRECTION, RATE OF FLOW, MOVEMENT OF POLLUTANTS.

Since its inception, the Environmental Geosciences Program has received dozens of inquiries from principal investigators who were encouraged to submit proposals to the EPA or to NSF's Engineering Division. No proposals were received by the Program that could be considered for joint funding with EPA.

Through coordination by NSF's Division of Astronomy, the NSF has made facilities available at Kitt Peak National Observatory (KPNO) for a research project on atmospheric carbon dioxide monitoring. This research is conducted in cooperation with the U.S. Department of Energy's (DOE) effort to evaluate solar absorption spectroscopy as a tool that can be used in the study of atmospheric CO_2 concentration. Facilities at the observatory are used to collect very high resolution Fourier Transform Spectrometer (FTS) spectra of the sun on a monthly basis as scheduling and weather allow. These spectra are taken in consultation with DOE's Pacific Northwest Laboratory (PNL).

The Division of Astronomical Sciences is very concerned with the environment of astronomical observatories, especially the protection of observatories from man-made electromagnetic interference such as "light pollution" or use of frequency bands needed for radio astronomy.

As an agency devoted to fundamental scientific advancement, NSF does not fund programs directed towards specific environmental problems. NSF funding for projects related to environmental concerns is not differentiated into those portions of the research project which relate to an environmental problem and those portions which do not. For this reason it would be inappropriate to attempt to quote funding levels for environmental research directed towards

PROBLEMS. IT SHOULD BE NOTED THAT RESEARCH PROJECTS WHICH BEAR SOME RELATION TO ENVIRONMENTAL CONCERNS RECEIVE FUNDING RANGING FROM SMALLER PROJECT GRANTS OF $50,000 TO LARGE STUDIES WHICH RECEIVE SEVERAL MILLION DOLLARS ANNUALLY.

IT SHOULD BE MENTIONED THAT NSF HAS NOT EXPERIENCED ANY SIGNIFICANT IMPACT RESULTING FROM CUTBACKS IN EPA FUNDING. CUTBACKS ON ALREADY MINOR EPA FUNDING OF OCEANOGRAPHIC RESEARCH RESULTED IN A FEW INVESTIGATORS COMING TO NSF WITH PROPOSALS TO COMPENSATE FOR LOSS OF EPA FUNDS. ONE EXAMPLE IS THE MARINE ECOSYSTEM RESEARCH LABORATORY (MERL) AT THE UNIVERSITY OF RHODE ISLAND. THE FACILITY WAS CONSTRUCTED IN 1976 AND INITALLY WAS SUPPORTED MOSTLY BY EPA FUNDS. WHILE THE EPA CUTBACK RESULTED IN A SLIGHT INCREASE OF THE BUDGETARY DEMANDS ON THE NSF/OCE BUDGET, IT ALSO HAS MADE A VALUABLE FACILITY MORE AVAILABLE FOR BASIC RESEARCH ON THE CHEMICAL AND BIOLOGICAL DYNAMICS OF ESTUARIES.

THE FIRST-ORDER USE OF INFORMATION GENERATED BY NSF-SUPPORTED RESEARCH IS BY SCIENTISTS. THEREFORE, THE PRIMARY POINT OF DISSEMINATION IS IN THE PROFESSIONAL JOURNAL. ONE CRITERION IN THE PEER REVIEW PROCESS IS THE EFFECTIVENESS OF THE PROPOSER IN MAKING RESEARCH RESULTS AVAILABLE. HOWEVER, WHERE TOPICAL INTERESTS DICTATE, NSF, OFTEN IN COOPERATIVE EFFORTS WITH OTHER FEDERAL AGENCIES, SUPPORTS WORKSHOP, SYMPOSIA, AND PUBLICATIONS THAT BRING TOGETHER SCIENTISTS AND THOSE CONCERNED WITH POLICY. A RECENT EXAMPLE ILLUSTRATING SUCH COOPERATION IS "CO_2 AND PLANTS: THE RESPONSE OF PLANTS TO RISING LEVELS OF CARBON DIOXIDE," AAAS SELECTED SYMPOSIUM 84 (1983). EIGHT PRIVATE AND FEDERAL ORGANIZATIONS UNDERWROTE THIS PARTICULAR CONFERENCE.

IN ADDITION, ANY REPORTS RESULTING FROM NSF-SUPPORTED RESEARCH ARE SENT TO THE NATIONAL TECHNICAL INFORMATION SERVICE FOR DISTRIBUTION TO THE PUBLIC.

THIS CONCLUDES THE NATIONAL SCIENCE FOUNDATION'S TESTIMONY BEFORE THE SUBCOMMITTEE. I THANK YOU FOR THE OPPORTUNITY TO DESCRIBE NSF'S PROGRAMS.

THANK YOU MR. CHAIRMAN.

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICE OF THE
ASSISTANT DIRECTOR
FOR ASTRONOMICAL,
ATMOSPHERIC, EARTH,
AND OCEAN SCIENCES

November 21, 1983

Ms. Heather Wicke
Subcommittee on Toxic Substances and
Environmental Oversight
Committee on Environment and Public Works
United States Senate
Washington, D.C. 20510

Dear Ms. Wicke:

Enclosed please find the questions and answers requested by Senators Durenberger and Baucus regarding my testimony before the Subcommittee on Toxic Substances and Environmental Oversight on the subject of Federal environmental research and development.

If you should require additional information, please contact Barbara Patala of my staff on 357-7615.

Sincerely,

Albert Bridgewater

Albert L. Bridgewater
Acting Assistant Director

Enclosure

Senator Baucus' Questions:

1. Question: While many other non-defense government research programs have been trimmed back considerably in recent years, the NSF budget has continued to grow.

--To what do you attribute the fact that this Administration has continued to be very supportive of NSF?

Answer--The large increase requested for the Foundation in FY 1984, reflects the importance the Administration has assigned to basic research for laying the groundwork for long-term, stable economic recovery and growth and for providing the foundation for technologies on which national security and other national goals depend. With this goes the recognition that the United States needs to begin modernizing the research and instrumentation base of its colleges and universities. The increase also will help to improve the quality of science and mathematics training in our schools so that the Nation may obtain outstanding scientists and engineers and well prepared technicians to maintain and improve the United States' leadership in science and technology.

Question: A major complaint regarding many environmental research efforts has been the lack of stability based on the annual appropriation process. Do you have any suggestions for providing a more stable atmosphere to these programs, and otherwise encouraging the pursuit of long-term exploratory work?

Answer--This question surfaces a number of complex and interrelated issues. A research program should be supported over the long-term only on the basis of a strong scientific justification for doing so, not because it is a long-term program. While scientific consensus on merits of particular programs is often difficult to come by, it is this sort of judgement that must be used, based on full hearing of all arguments pro and con. The annual appropriation process is not at fault in such decisions on research priorities except for the essential and ever present need to establish priorities. In any alternate appropriation scheme, priorities would still require choices to be made.

Environmental monitoring of long-term trends in air and water quality, etc., should not be confused with environmental research. With respect to environmental monitoring, the appropriation process may not be at fault. Rather, the greater concern may be the relatively lower priorities given to environmental measurements obtained to determine trends in the state of some aspect of the environment. A multi-year appropriation process would have no impact on the stability of environmental monitoring programs if priorities remain unchanged. This and other problems associated with environmental monitoring were discussed before the House of Representatives, Committee on Science and Technology, Subcommittee on Natural Resources, Agriculture Research and Environment, May 19 and 26, 1983.

The Foundation makes awards of up to 5 years duration. The longer term awards often are used to support environmental research where the nature of the research question requires long-term study. Such grants are usually made on an annual basis contingent on availability of funds and evidence of satisfactory progress toward the research objectives. Having made a conscious decision that long-term support of certain research projects is essential to progress in environmental research, these continuing commitments have a high priority assigned to them and are planned for accordingly in the budget process.

2. Question: The EPA FY 1984 budget request indicated that funds and substantial responsibility for managing the Peer Review Grants program would be shifted to the National Science Foundation. It is my understanding that this plan is not going to be implemented.

--What was the National Science Foundation position on this idea?

Answer--The Foundation was prepared to carry out those duties if they were assigned.

--Does the National Science Foundation manage any other Government agency grant programs?

Answer--No.

Senator Durenberger's Questions:

1. Question: The research activities you describe are university-directed and long-term in focus. Can you compare some of the differences between the results and costs of Federal research programs based in-house and one which relies on outside academic expertise?

Answer--The National Science Foundation was established as an independent agency of the Federal Government in 1950 to promote and advance scientific progress in the United States. The Foundation accomplishes this mission by supporting scientific research, primarily at colleges and universities, and by supporting selected activities in science and engineering activities. In contrast to other agencies with a research mission, NSF does not itself conduct research. Therefore, we do not have the basis for the comparison of intramural versus extramural research programs that the Committee seeks.

We believe, however, that there is an appropriate role for both types of programs. Because the NSF role is to promote scientific advances on the broadest possible front, our purposes are best served by extramural support, taking fullest advantage of the best ideas of the Nation's scientists and engineers irrespective of specific short-term goals. In mission agencies where major facilities must be dedicated to a long- (or short) term goal, where the problem is of continuing importance, or where a critical mass of diverse scientific and engineering expertise must be brought to bear, there are unique benefits of in-house research programs. Given the broad range of scientific and technological challenges before us, the important question is how to take maximum advantage of both types of research programs to solve these problems.

2. Question: You stated that NSF research is investigator initiated by submission of proposals from universities. Is the contract selection process influenced at all by the views of regulators or other professionals on long-term priorities and problems?

Answer--There are four principal criteria used by NSF to select research proposals for support:

1. competent peformance of the research
2. intrinsic merit of the research
3. utility or relevance of the research, and
4. effect of the research on the infrastructure of science and engineering.

STATEMENT OF
DR. NED A. OSTENSO
ACTING ASSISTANT ADMINISTRATOR FOR
OCEANIC AND ATMOSPHERIC RESEARCH
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE

SUBCOMMITTEE ON TOXIC SUBSTANCES AND ENVIRONMENTAL OVERSIGHT
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

UNITED STATES SENATE

OCTOBER 17, 1983

Mr. Chairman and Members of the Subcommittee:

I am Ned Ostenso and I serve as the Acting Assistant Administrator for Oceanic and Atmospheric Research of the National Oceanic and Atmospheric Administration (NOAA). I am pleased to be here today to talk about NOAA's environmental research activities. I propose to outline briefly the broad-based research programs managed by the Office of Oceanic and Atmospheric Research (OAR) and then describe selected NOAA activities directly connected to environmental research and development issues.

OAR Research Activities

OAR conducts and supports research through three line organizations: the Office of Climate and Atmospheric Research, the Office of Sea Grant and Extramural Programs, and the Environmental Research Laboratories. The principal objective of these activities is to promote a better understanding of the atmospheric, coastal-oceanic and geophysical processes underlying the work of NOAA's service-oriented components.

The Office of Climate and Atmospheric Research manages and coordinates atmospheric, oceanic and climatic research projects that are largely interagency or international in scope. These include responsibilities for coordinating and implementing U.S. activities in the Global Atmospheric Research Program (GARP) and implementing U.S. projects under the World Climate Research Program.

The Office of Sea Grant and Extramural Programs administers the National Sea Grant College Program, which is an academically based program of research, education and advisory services aimed at development, utilization and management of Great Lakes and offshore resources of the United States. The Office also manages the NOAA Undersea Research Program and is responsible for promoting university affairs within NOAA. These programs support NOAA's missions in atmospheric, ocean and climate services, in resource management and in environmental quality.

The Environmental Research Laboratories (ERL), headquartered in Boulder, Colorado, conduct most of NOAA's in-house research. There are nine major laboratories in seven states. In addition to these laboratories, joint institutes have been established in various universities to undertake research for ERL. The laboratories also supplement their in-house research through contracts and grants sponsored by the individual laboratories or by the Office of the Director. ERL activities are concentrated in seven major programs:

- Weather Observation and Prediction
- Air Quality Research
- Climate Research
- Solar-Terrestrial Services and Research
- Marine Observation and Prediction
- Marine Assessment Research and Services
- Marine Resources Research and Services

Chesapeake Bay

In response to the Chesapeake Bay Research Coordination Act of 1980, NOAA has organized an ad hoc research coordination committee comprising one representative from each of the Federal agencies sponsoring research in the Bay, three selected by the Governor of Maryland and three by the Governor of Virginia.

The committee has complimented Bay organizations such as the Bi-State Working Committee, Chesapeake Bay Research Consortium, and the Maryland and Virginia Sea Grant Programs. The Committee has participated in the development and approval of a research plan, the identification of research priorities, the design and approval of monitoring studies and the interpretation of research results. It should also provide a means for communicating research needs and results among Bay scientists and managers.

Acid Rain

NOAA also has a significant research program in acid rain, an environmental issue presently receiving a great deal of national and international attention. OAR research is concentrating on sources, transport and deposition of acidic materials.

Natural Sources

Special studies of biogenic sulfur sources from the ocean have been conducted by two of our ocean laboratories. Results to date have pointed to the Gulf of Mexico as a possible important source.

Studies have been initiated under contract to three major universities to study land sources of natural acid-forming gases. The role of alkaline dust in neutralizing acidity is also being investigated.

Atmospheric Processes

Special transport studies using inert tracers (CAPTEX) are being planned for October, 1983. These experiments will help evaluate long-range transport of acidic materials.

The transport of pollutants off the North American coastline is important in establishing the overall acid rain budget. NOAA, the Universities of Virginia, Delaware and Miami, the Bermuda Biological Station, General Motors Laboratory and the Canadian Atmospheric Environment Service are participating.

Deposition Monitoring

NOAA has responsibility for the Global Trends Network, eight stations around the world that routinely take atmospheric quality measurements. Background acidity of precipitation in remote areas is higher than originally expected. NOAA also participates with 15 sites (WMO regional and baseline) in the National Trends Network. Special research sites have been established to study both wet and dry deposition, employing new measurement and collection techniques.

Regional Ocean Pollution Projects

NOAA's goal in ocean pollution research is to provide the best available scientific information on marine environmental quality to policy-makers in Congress, other Federal agencies, state and local governments, industry and the public to support balanced management of the Nation's coastal waters and oceans. We are working on contaminant distribution and biological response in selected coastal waters such as the heavily used

Hudson-Raritan estuary and Puget Sound, studying a recently abandoned sewage-sludge site off the Mid-Atlantic Coast, completing comparative analyses of coastal outfalls versus barge dumping of pharmaceutical wastes, and continuing research on sewage-sludge disposal off Southern California. Next year we plan to refocus our efforts on broad national consensus, and we will place high priority on quality assurance and inter-regional comparability of marine environmental data. NOAA will continue its efforts to assess long-term trends in environmental quality, especially in highly stressed locations.

Conclusion

Mr. Chairman, acid rain is only one of several aspects of air quality research in which NOAA is active. It is widely believed that man's activities are causing fundamental changes in the constituents of the atmosphere. Indeed, CO_2, chlorofluorocarbons, methane and other compounds are found in greater concentrations than heretofore. These species not only pollute the atmosphere, they also possess radiative properties which contribute to changes in climate. For example, a mass of data suggests that CO_2, through the infamous "greenhouse" effect, can warm the atmosphere, which in turn could alter patterns of rainfall, temperature, water vapor, prevailing winds and so on -- all of major importance to the world economy. Recently similar increases in concentrations of other radiatively important trace species have been monitored, and there is general concern that these species will amplify climatic effects of CO_2. In view of these findings NOAA has begun to focus more attention on these species.

Mr. Chairman, my prepared statement concludes here. I welcome your questions.

QUESTIONS FOR DR. NED OSTENSO--N.O.A.A.
Submitted by Senator Durenberger

1. Q. You have not supplied the Subcommittee with historical budget figures for the programs you describe. What has been the percentage reduction in funding levels from 1980 to 1984? Briefly describe the changing research priorities these reductions reflect.

A. The requested history, including percentage reductions, is provided in the attached table. The changing research priorities reflected in this history include:

- A shift in global atmospheric research from emphasis on weather phenomena extending only a few weeks into the future to climate phenomena extending for longer periods into the future.
- A shift in climate research from primary emphasis on atmospheric processes to an equal emphasis on oceanic processes and their interaction with the atmosphere.
- An increasing emphasis on research on the processes underlying acid precipitation, and especially on natural sources of the responsible substances as distinct from sources resulting from human activities.
- A shift in research on possible climate warming through the "greenhouse" effect from unique attention to carbon dioxide as a possible causative agent to include attention to a number of radiatively important trace species.
- Termination of research in weather modification by statistical analysis of empirical cloud seeding procedures without scientific understanding of the governing physical processes.
- Increasing emphasis on mesoscale weather research on the important effects of interaction among individual convective clouds within mesoscale convective complex systems of sizes corresponding to several states.
- Increasing emphasis in weather and marine prediction development research on methods for producing integrated presentations of information of numerous kinds from numerous sources and types of sources.
- Increasing emphasis on research on the newly discovered, and still emerging, unexpected physical, chemical, and biological processes which occur near tectonically active ridges on the ocean floor where crustal processes are recycling the Earth's substances with surprising and potentially valuable results in terms of hydrothermal mineral resources, ocean quality, and forms of life which derive their basic life energy from volcanic (geothermal) forces rather than from the Sun as most life forms do.

FUNDING HISTORY - SELECTED NOAA ENVIRONMENTAL RESEARCH

	$K FY80	FY81	FY82	FY83	FY84	%Decrease FY80-84
GARP	(5,466)	(5,467)	(5,334)	(5,394)	(4,172)	24
GATE	1,543	0	0	0	0	
FGGE	3,923	3,836	3,633	3,632	2,532	
WCRP	0	1,631	1,701	1,762	1,640	
Ocean Climate Research	(2,779)	(3,567)	(3,567)	(3,567)	(7,267)	Increase
EPOCS	2,779	2,779	2,779	2,779	2,779	
STACS	0	788	788	788	788	
OACIS/TOGA	0	0	0	0	3,700	
Sea Grant Collge Program	38,700	41,800	35,000	35,000	36,500	
NOAA Undersea Research Program	3,235	2,694	3,399	5,928	4,785	Increase
Great Lakes Environmental Research Laboratory Program	3,321	3,476	3,644	3,644	3,644	Increase
Chesapeake Bay	0	0	0	250	300	Increase
Acid Rain	(270)	(150)	(1,770)	(2,070)	(2,870)	Increase
Natural Sources	0	0	545	635	870	
Atmospheric Processes	0	0	570	665	950	
Deposition Monitoring	270	150	655	770	1,080	
Carbon Dioxide	900	900	900	800	800	11
Radiatively Important Trace Species	50	50	50	60	60	Increase
Polymetallic Sulfides (Seafloor Spreading Processes)	0	0	0	800	2,000	Increase
Regional Ocean Pollution Projects Ocean Pollution Research	See response to question 3.					

Numbers in parenthesis ( ) are the sums of the subitem nmbers immediately below them.

ACRONYMS

GARP - Global Atmospheric Research Program

GATE - GARP Atlantic Tropical Experiment

FGGE - First GARP Global Experiment

EPOCS - Equatorial Pacific Ocean Climate Studies

STACS - Subtropical Atlantic Climate Studies

OACIS - Ocean Atmosphere Climate Interaction Studies

TOGA - Tropical Ocean-Global Atmosphere

QUESTIONS FOR DR. NED OSTENSO-- N.O.A.A.
Submitted by Senator Durenberger

2. Q. How do these percentage reductions compare with R&D figures for the same period at EPA, DOE, and DOI?

A. The National Science Foundation's detailed Statistical Tables of Federal Funds for Research and Development -- FY 1982-1984 describes research and development obligations and outlays for all federal agencies and Departments during that period. According to this review the President's budget proposal for FY 1984 represented a 36 percent reduction in total NOAA research and development funding. At the same time, the total research and development obligations for DOE, DOI and EPA would decrease as follows:

DOE............4 percent
DOI............14 percent (with a proposed increase in FY 1983)
EPA............38 percent

Similarly, the NSF report illustrates that estimated R&D obligations for the category of "environmental sciences" represent the following reductions:

NOAA............34 percent
DOE............2.4 percent
DOI............11 percent
EPA............42 percent

3. Q. You enumerated NOAA's activities in ocean pollution research focusing on effects of off-shore discharge of pollutants on East and West coast waters. Does the phrase "we plan to refocus our efforts on broad national consensus" in your testimony suggest a decline in these research activities? What are the funding levels for ocean pollution research for the years 1980-1984? Is any other federal agency besides NOAA fulfilling these important research needs?

A. Several federal agencies are conducting ocean pollution research, development and monitoring. The National Marine Pollution Program Office (NMPPO) indicates (Table 1) that seven Federal Departments and four independent federal agencies are participating in recent National Program activities (FY 1981-84). Table 2 provides a NMPPO breakout of the NOAA activities into 20 specific programs. Our future efforts in ocean pollution research are intended to address national concerns and will focus on processes and problems common to a variety of water systems rather than focusing only on specific regions. Within OAR, our activities primarily involve the Long Range Effects Research Program (Program number 2 on the attached table). You will note that no reduction in this activity is planned.

Table 1. National Marine Pollution Program Funding Levels: FY 1981-1984 (funding in thousands of dollars).

Agency	FY 1981 Estimates	FY 1982 Estimates	FY 1983 Estimates	FY 1984 Presidential Budget
Department of Agriculture	196	196	196	196
Department of Commerce				
National Bureau of Standards*	0	0	0	0
National Oceanic and Atmospheric Administration	35,778	36,923	34,482	16,912
Department of Defense				
Army Corps of Engineers	8,921	9,391	9,827	10,507
U.S. Navy	436	1,039	1,125	1,100
Department of Energy	23,236	20,268	22,151	22,151
Department of Health and Human Services				
Food and Drug Administration	2,100	2,100	2,150	2,250
National Institute of Environmental Health Services	1,408	1,043	1,330	1,358
Department of the Interior				
Minerals Management Service	35,368	31,962	29,388	29,388
Fish and Wildlife Service	2,900	2,884	2,369	2,366
U.S. Geological Survey	8,080	6,617	5,386	5,300
Department of Transportation				
U.S. Coast Guard	3,072	4,236	3,803	4,122
Environmental Protection Agency	24,955	18,320	14,615	11,040
National Aeronautics and Space Administration	2,140	1,900	2,050	0
National Science Foundation	2,600	2,496	2,496	2,100
Nuclear Regulatory Commission	432	265	0	0
TOTAL	$151,622	$139,640	$131,368	$108,790

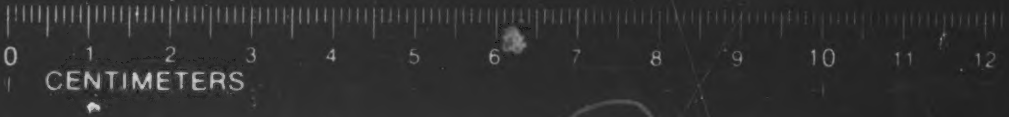
* This program shows no funding because support is provided from other agencies on a reimbursable basis.

Table 2

DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

PROGRAM FUNDING SUMMARY
RELATES TO OCEAN POLLUTION RESEARCH, DEVELOPMENT AND MONITORING
FISCAL YEARS 1981-1984

	(in Thousand Dollars)			
	FY 81	FY 82	FY 83 (est.)	FY 84 (est.)
Ocean Dumping	2,470	2,481	2,516	0
Long-Range Effects Research	4,835	4,811	4,871	4,871
Hudson-Raritan Estuary	1,450	1,210	1,232	0
Puget Sound	1,301	1,106	1,000	0
ERL Great Lakes Pollution Studies	2,364	2,478	2,478	0
Chesapeake Bay Program	0	0	250	0
Habitat Investigations	3,865	3,865	4,115	976
Measurement Systems Development and Engineering Services	600	560	241	0
Ocean Pollution Monitoring Program (NEMP)	750	752	757	0
Microconstituents	181	181	181	90
Hazardous Materials Spill Response Project	950	932	945	945
Ocean Thermal Energy Conversion (OTEC)	60	208	200	0
Deep Seabed Mining Environmental Research	250	450	535	435
Ocean Resources Coordination and Assessment	400	600	600	600
Sea Grant Ocean Pollution	2,277	2,091	2,091	0
ERL Ocean Pollution Studies	1,500	2,490	2,490	2,218
Financial Assistance	1,407	1,407	1,426	1,426
Ship and General Support Activities	10,061	10,061	7,320	4,108
National Marine Pollution Program Office	645	680	674	683
Ocean Pollution Data and Information Network	412	560	560	560
NOAA TOTAL	35,778	36,923	34,482	16,912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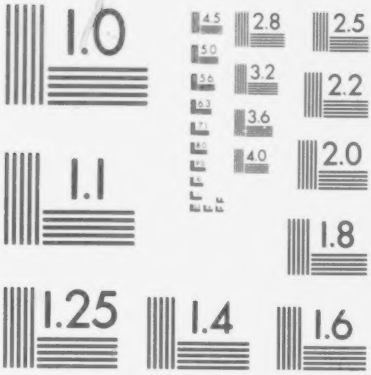
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